SCIENTIFIC AMERICAN

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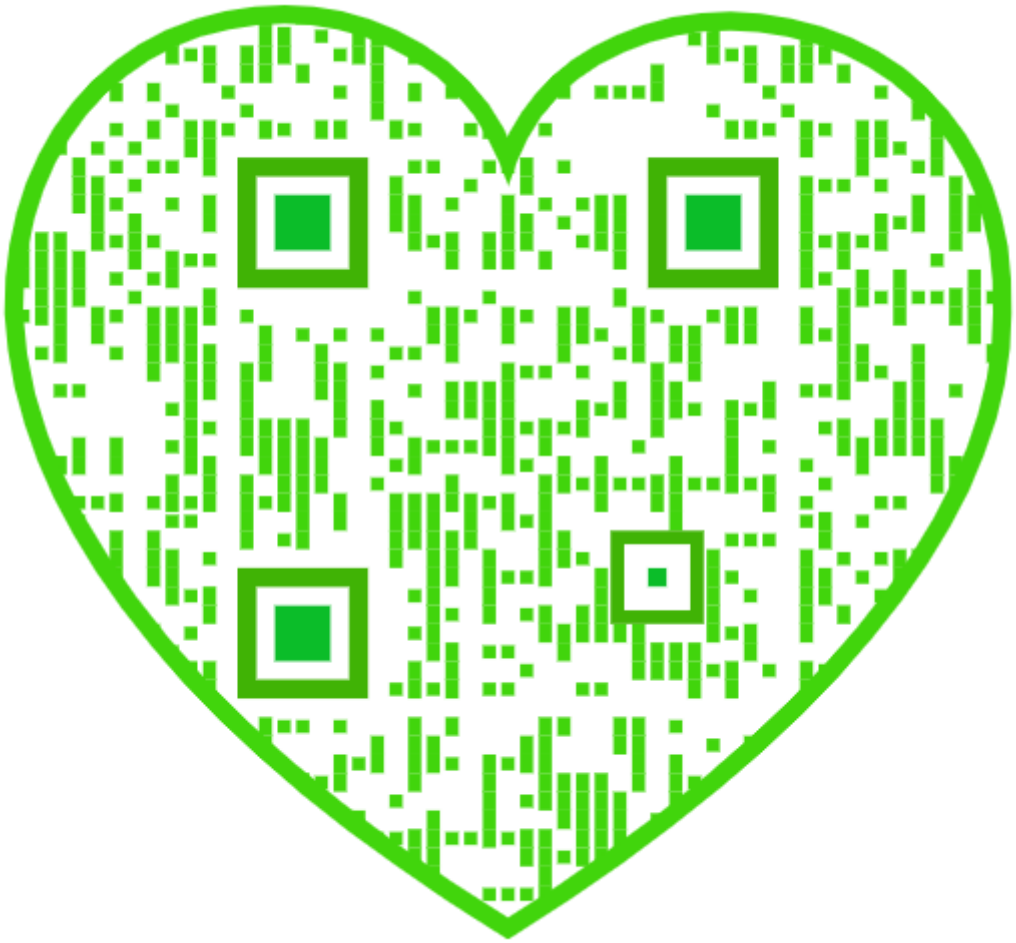
From L'Illustration.

A Photograph of the German Crown Prince Electrically Transmitted to a Distance of Nearly 1,100 Miles. The Small Picture, from Which the Enlargement Was Made, is the Actual Result Obtained With the New Method.

KORN'S PHOTOGRAPHIC FAC-SIMILE TELEGRAPHY.—[See page 148.]



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NEW YORK, SATURDAY, FEBRUARY 16, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

GOVERNMENT REGULATION OF NIAGARA POWER.

The decision recently promulgated, under the Burton act, by Secretary of War Taft regarding government regulation of the utilization of the hydraulic power of Niagara Falls, has put a very effective stop to the alarming encroachments which the various power companies were making on the volume of the upper Niagara River, upon which the world-famous Falls depend for their scenic beauty. The decision allows the various existing companies on the American side to draw from the upper river volumes of water which are practically the same as those which are now utilized, and are permitted, as a maximum amount, by the provisions of the Burton act. The Niagara Falls Power Company may take 8,600 cubic feet per second, and the Niagara Falls Hydraulic Power and Manufacturing Company is restricted to 6,500 cubic feet per second. Power generated on the Canadian side may be imported in the following amounts: The International Railway Company, 1,500 horse-power; Ontario Power Company, 60,000 horse-power; Canadian-Niagara Falls Power Company, 52,500 horse-power; and the Electrical Development Company, 46,000 horse-power; making a total amount, which may be imported into the United States, of 160,000 horse-power. The Secretary of War may revoke these permits at his pleasure, and in any case, in the absence of any further legislation by Congress, they expire on June 29, 1909. Under these permits, there may be drawn from the upper river a total amount of 15,100 cubic feet per second on the American side, all of which is now being taken, and on the Canadian side they cover about 12,000 feet per second, of which last amount it is likely that about 5,000 cubic feet per second will be drawn during the three years covered by the permits. The volume of water passing over the Falls is estimated to be about 220,000 cubic feet per second; and as the total amount that will be drawn off during the coming three years is only about 20,000 cubic feet per second, it will be seen that the action of the United States government has effectively checked the desecration of the Falls, at least as far as American control of them is concerned, before it had proceeded to a point where the beauty and majesty of the Falls were seriously impaired.

Secretary Taft has done his work thoroughly; for not only is the further withdrawal of water to be prevented; but steps are to be taken to mitigate, if not remove, the unsightly conditions on the American side of the canyon below the Falls, the effect of which upon the sightseer is described as being that produced by looking at the backyard of a house negligently kept. A committee has been appointed to consider the question of restoring the American side of the canyon at this point, so as to put it once more in harmony with the Falls and other surroundings, and conceal, as far as possible, the raw commercial aspect that now offends the eye.

STUPENDOUS WATER SUPPLY SCHEME.

Three of the leading hydraulic engineers of the country have recently reported favorably upon what is probably the most daring municipal water supply scheme that has ever been projected. We refer to the proposal, which we understand has every prospect of being successfully prosecuted, to supply the city of Los Angeles and the surrounding district with an abundant supply of water drawn from the distant Sierra Mountains. The scheme involves, first, the construction of a conduit 226 miles in length, capable of supplying the city with a quarter of a billion gallons of water daily; second, the construction of large storage reservoirs, a single one of which will have the enormous capacity of 85 billion gallons of water; and lastly, the development of a total of 100,000 horsepower, available for six days of the week and nine hours of each day, the greater part of which can be developed within a distance of 45 miles of the city. The total cost of this very ambitious undertaking will be about $25,000,000. The guarantee for planning this work on a scale of such magnitude is to be found in the certain and very large income to be derived from the sale of water for irrigation purposes and for power, in and around a city which doubled its population in the ten years preceding the last census, and is recognized to-day as being, next to San Francisco, the most important commercial center in the flourishing State of California.

A SIMPLE-CYLINDER SUPERHEAT LOCOMOTIVE TEST.

An important question now being investigated by locomotive builders is the comparative efficiency of compound locomotives using high steam pressure and simple locomotives using low steam pressure with superheat. There has now been in operation on the Atchison, Topeka, and Santa Fé Railroad for over a year a simple-cylinder locomotive, which is identical with a class of compound locomotives operating on that road, in every particular except its cylinders, its boiler pressure, and the fact that it is provided with a superheater. The compound engines have tandem, compound cylinders, there being a 19-inch high and a 32-inch low on each side of the boiler, with a common stroke of 32 inches. The type was changed, in the experimental locomotive, by leaving out the 19-inch high-pressure cylinders (thus transforming the locomotive into a simple engine with two 32-inch diameter by 32-inch stroke cylinders), providing the boiler with a superheater, and lowering the pressure from 225 pounds of steam to 140 pounds, the superheater being built for the provision of 70 degrees of superheat. The locomotive started service with 130 pounds pressure, and this was successively raised to 135, 140, 145, finally to 150 pounds. The superheat ranged between 30 and 40 degrees. In spite of the failure to realize the expected 70 degrees of superheat, the locomotive has shown an efficiency within 5 per cent of that of the compound engines engaged in the same service. The record of this locomotive has been excellent, as is shown by the fact that it requires less repairs, and has been for a greater total time in service, than the compounds. Moreover, it is popular with the engineers, and by them preferred to the compound, not only because it requires less repairs, but on account of its adaptability to the water used on the division on which it has been working, which has the bad quality of excessive foaming. The absence of foaming is due to the drying-out effect of the superheater on the water carried over with the steam. The fuller data which will be available when the official report is made, will be awaited with no little interest. In this connection it should be noted that the value of superheated steam in locomotive service is to be investigated by Prof. Goss, of Purdue University, under a special grant of $3,000 a year for four years from the Carnegie Institution.

ONE YEAR'S WEAR OF A STEAM TURBINE.

The economy of the steam turbine in certain classes of service is fully established. Its mechanical durability, however, is not so well known, and indeed the serious wrecking of the blades in some of the earlier machines had raised a reasonable doubt upon this point. Valuable testimony to the wearing qualities of the Parsons turbine, however, was recently given in a report, by the vice-president and manager of the operating department of the Baltimore Power Company, on the condition and performance of the turbines at the Gold Street car station, where the equipment consists of three 2,800-horse-power steam turbine units, the first of which was placed in service in July, 1905, the second in August, 1905, and the third in April, 1906. Recently the second unit was opened, after eleven months of more or less constant service, and a thorough examination was made. The machine was found to be, as regards its general condition, as good as when first installed; and although saturated steam had been used, no blades were missing in either cylinder or spindle; nor was there any evidence of erosion, both edges of the blades and the steam surfaces of the same being intact. Furthermore, careful examination was made of the ends of the blades and of the inner surfaces of the cylinder which faced them, and also of the surface of the spindle barrels facing the ends of the blades which project inwardly from the cylinder. In neither case was there the slightest evidence of contact or rubbing between the two. Mechanically, then, this turbine must be admitted to have fulfilled every expectation.

As regards operation, the report states that the service rendered has been very satisfactory. The plant gives a twenty-four-hour service with a load varying from 12 to 15 per cent during week days, down to 5 to 8 per cent on Sundays. The turbines have shown that they are well suited to a high vacuum, no extraordinary trouble having been experienced in providing a vacuum within one inch of the barometer, particularly during cold weather. Notwithstanding the low load factor of 12 to 15 per cent, the station for one month averaged 3.36 pounds of coal per kilowatt hour generated, including all coal for banking and changing boilers, the coal being largely of bituminous mine cuttings. The corresponding water consumption of the station during the same month averaged 23.9 pounds per kilowatt hour. All of the condensed steam from the turbines is used for boiler feed water. During the same month the actual evaporation from a feed temperature of 180 deg. Fah. averaged 7.11 pounds of saturated steam per pound of coal. In concluding the report, the vice-president states that from an operating standpoint, steam-turbine motive-power equipment has proved eminently successful. It has been found to be entirely suitable for central station service, permanent in construction and adjustment, and economical of steam especially at low loads. Finally, the turbine plant is simple to operate, requiring less attention both skilled and unskilled than a reciprocating engine plant of corresponding size.

REINFORCED CONCRETE CONSTRUCTION ON THE PACIFIC COAST.

Already it is quite apparent that reinforced concrete is to enter largely in the reconstruction of San Francisco. There is scarcely a block in the downtown burned district that will not soon boast of at least one reinforced concrete building, for they are to be seen on every hand in various stages of construction. A five-story building on the corner of Geary and Market Streets, is the first structure of this kind to be occupied, while several others of from three to seven stories are in course of erection.

The most notable reinforced concrete building which has yet been announced for San Francisco is to be erected on the corner of Fourth and Market Streets, the site of the old Flood Building. It will be nine stories high and will cost $1,000,000. Its exterior, for the first two stories, will be veneered with ceramic tile in rich browns. Above the second story the entire front will be faced with cream-colored glazed terra cotta in rich detail. The corridors and lobbies will be finished in imported marbles, and six electric high-speed elevators will be installed. One remarkable feature of this concrete structure is the fact that nine stories are made possible within the limit of height to which concrete buildings are restricted by the city ordinance—one hundred and two feet. The first story will have a height of twenty feet; the second, twelve feet; and the other stories, ten feet each. By an ingenious arrangement of the structure, the fact that the roof is of concrete makes it possible to dispense entirely with an attic story.

The concrete firms declare that no other construction will stand fire and earthquake as well as reinforced concrete; and according to investigations made by the California Promotion Committee, it would seem that the facts bear out this assertion. It is well known, for example, that the museum at Stanford University was built seventeen years ago of reinforced concrete, being the first building of its kind in California. As compared with our modern methods, it was a very crude example of reinforced concrete construction. Nevertheless, it stood the earthquake admirably. One statue was thrown from the top, and all the marble statuary in the interior was toppled to the floor and broken. The pictures on the walls were swung with their faces toward the wall. However, the building sustained no damage, not even being cracked in the slightest extent. The girls' dormitory was also of concrete construction except in the roof. The roof was badly damaged, but the remainder of the building was only slightly injured.

In San Francisco, the Bekins warehouse was constructed with brick walls, and reinforced concrete for all other parts, such as floors, girders, and interior columns. This building sustained practically no damage either from fire or earthquake. At the time of the quake the building was under construction, and but two stories had been completed. The first story had already been filled with inflammable merchandise, which was entirely consumed. The building was not damaged in the least.

There were many other buildings in San Francisco having reinforced concrete floors. The National Board of Fire Underwriters' report of the San Francisco disaster shows that less than five per cent of these reinforced concrete floors were damaged.

In the Baltimore fire there were two buildings of reinforced concrete in the hottest part of the conflagration. One of these was five stories high with brick walls, and all the interior construction of reinforced concrete. The brick walls were destroyed by the intense heat, leaving the entire interior construction standing, with the full five stories practically undamaged, and requiring only the outer walls to be replaced to fit the building for use. The other building was a bank. The first two stories were of reinforced concrete construction, with three stories above of brick and timber. The upper stories were entirely destroyed, heaping great piles of debris into the top of the two concrete floors. The two concrete stories suffered no damage, not even the woodwork being burned.

In Los Angeles, reinforced concrete has been more extensively used than in any other city in the United States up to the present time. The immense Audi-

torium Building, which has just been opened with a season of grand opera, is unique in many ways. It is noted for three features which have never before been undertaken in reinforced concrete construction—a concrete roof construction, a great balcony overhang, and cement girders carrying extraordinary loads. The balcony was loaded with a test load of 680 pounds to the square foot and, as the overhang is 31 feet, it was expected that the deflection would be considerable. As a matter of fact, it was only one-twelfth of an inch on the front. Great trusses were used in this building, 112 feet in height, with a depth in the center of 11 feet. When the false work was removed, they showed so little deflection that it was hardly measurable. With an applied load of 100 pounds to the foot, they showed a deflection of only an eighth of an inch. The girders make a span of 42 feet and have a depth of 63 inches. They carry a concentrated load of 100 pounds to the foot, the center load being a concrete column running through five stories and an attic. While greater spans for bridge work have been executed in reinforced concrete, no roof construction has ever been attempted before that approaches this in magnitude. It suggests the wide range of application of reinforced concrete construction, which, although it is extending so rapidly, is still in its infancy.

THE ODORS OF METALS.

The statement found in most treatises, that metals are inodorous, is contradicted by the most elementary daily observation.

According to experiments recently made by Herr C. Gruhn, of Berlin, the mechanism of smell, at least in the case of metals, is, however, entirely different. The following account of these researches will even show the very general interest attaching to this problem. He found that a piece of old metal (copper, aluminium, tin, zinc, iron, lead, etc.) at ordinary temperatures possesses a slight smell which many persons are unable to detect. The same piece of metal having been heated above a lamp to a moderate temperature is found to give out a very strong smell, which is readily distinguished by any one. From experiments so far made, it would seem that the condition (either pure or oxidized) of the surface of the metal does not exert any influence on the quality or intensity of this smell.

If a piece of metal be heated during some length of time (about an hour), its temperature being kept constant, it at first gives out a very strong smell, which, however, gradually decreases in intensity, until it is just equivalent to the smell given out in the cold state. If, however, the heating be discontinued and the metal cooled, it no longer shows the least trace of smell. Another heating effected immediately afterward will produce only a feeble smell; the metal thus appears to have become well-nigh exhausted.

If the same increase in temperature be imparted to another sample of the same metal, the stronger effects of the fresh metal become specially striking. These phenomena always occur in exactly the same manner.

Gruhn infers that the matter vaporized during the heating is not identical with the metal itself. In fact, it would be difficult to understand why the vaporization of the metal should eventually cease in the case of a prolonged heating. It certainly could be objected that a prolonged heating would result in the production of an oxide layer at the surface of the metal, putting an end to vaporization. The experiments described, however, show that a layer of oxide in no way interferes with the emission of smell from a heated metal.

The phenomena described in the following experiment afford a very striking evidence of Herr Gruhn's hypothesis. A piece of metal having been deprived of its smell and kept in the cold state during two to three hours, is heated anew. It is then found to have been restored to its previous power, smelling as strongly as a fresh piece of metal. This experiment can be repeated over again with the same success any number of times.

It should be remembered that the temperatures involved are by no means excessive, a temperature of 122 deg. F. being quite sufficient. In fact, a fresh piece of metal will give out a rather strong smell even on being heated through 40 to 50 deg. F.

From these experiments Herr Gruhn draws the conclusion that the metal continually gives out an emanation of gaseous matter, composed, not of atoms of the metal, but rather of a product of transformation from these atoms. The metal possesses the power of storing this odorous matter in the same way as carbonic acid is stored in water. To each given temperature corresponds a maximum amount of odorous matter which the metal is capable of retaining. The metal thus becomes saturated. A voluntary prolonged cooling should accordingly result in a more copious accumulation of odorous matter in the metal. This is really borne out by Herr Gruhn's experiments.

The experimenter has finally succeeded in separating and isolating in a vessel the odor given out from a metal, which thus behaves in exactly the same way as the emanations of radioactive bodies.

The odoriferous phenomena described are probably not characteristic of metals only, but are shared by all bodies, and being perfectly analogous to radioactive phenomena, point to the existence of some universal law.

Radioactive salts are known likewise to give out spontaneously and continually an emanation of gaseous matter that in a similar way is driven out by heat, only to be incessantly reformed during a prolonged rest in the cold state. While the radioactive emanation is gaged by the ionization of air, the odorous emanation of metals is gaged by the nose. The various radioactive emanations have been found on the other hand to undergo multiple conversions, eventually passing into a stable condition, as illustrated by the chain of conversions leading from radium to helium. In view of the universal analogies exhibited by the laws of nature, the odors of metals are likely to pass through a similar series of transformations as radioactive emanations. There is no reason for supposing that the electroscope, which has rendered such excellent service in detecting radioactive substances, will suffice for perceiving all emanations that may be discovered in the future. It will rather be the task of science to look for ever-new reagents enlarging our perceptive faculties. Such a means of extending the scope of our senses is for instance the torsional balance, by means of which Herr Gruhn has been able to ascertain the existence of peculiar emanations in the atmosphere.

AERIAL NAVIGATION PRIZES.

Of a somewhat sensational nature is the announcement of a $50,000 aeronautic prize offered at Paris. The prize in question is to be awarded for an aerial flight from Paris to London, and the largest part of the sum is subscribed by one of the leading daily journals, Le Matin, which offers $20,000. The remainder is subscribed in equal portions of $10,000 by Marquis de Dion, M. Clement, and M. Charley, all three of whom figure prominently in the automobile world. According to the rules which have already appeared regarding the contest, the event will take place in 1908 and there are two essential points, first, that all possible kinds of aerial craft are admitted to the contest, and second, that the motors employed on all the flying machines must be of French construction. The aeronauts themselves may, however, be of any nationality. In any event, not regarding the state of the atmosphere, the start will take place from Paris on the 14th of July (the national holiday), 1908. Should the $50,000 prize not be won at that time, other starts will be fixed for the second Sundays of August, September, and October so as to have the event closed in the year 1908 if possible. The distance is 212 miles.

The amount of the prize will be awarded directly by the donors to the proprietor of the winning flyer who arrives the first within a maximum period of twenty-four hours exclusively through the air and using only the power contained within such apparatus. For the start a point will be fixed in or near the city at a later date. The finish will be noted by the dropping of a marked bag from the flyer, which is to fall within a circle of 25 meters (82 feet) radius about the finish point. Ten o'clock in the morning is the hour fixed for the start. It is to be noted that stops *en route* are to be allowed for taking on fuel and other supplies. All the motors are to be of French make. Closing of the engagement lists will take place thirty days before each start. No competitors will be allowed to enter who have not made a good performance beforehand with their aerial flyers, according to the testimony of reliable persons. Questions which are not settled by the regulations may be brought before the committee for decision, and this will be final. The announcement of such a large prize has awakened a great interest, as may be naturally expected, in aeronautic circles in Paris and elsewhere, and it will go far toward stimulating the activity of aeronauts, especially in France.

When the Daily Mail offered the sum of £10,000 ($50,000) on certain conditions for an aeroplane flight from London to Manchester, The Car, a London automobile paper, offered through the medium of the Daily Mail £5 ($25) per mile with the low minimum of twenty-five miles to be covered, and a challenge trophy value of 500 guineas ($2,500) for the longest flight taken in Great Britain in any one year.

The Brooklands Automobile Racing Club, of England, offers a money prize of £2,500 ($12,500) for any aeronaut who wins a race in the air by covering the prescribed course once. The date of the race will probably be in June or July next, so as to give plenty of time for construction and experiments. The prize will be given to the owner of any aeroplane, heavier than air, which completes the circuit of the Brooklands motor course (a three-mile track 100 feet wide) without touching ground from start to finish, at an altitude of between 30 and 50 feet, or thereabout, from the surface of the track. This offer is open from the day of the public opening of the motor course until December 31, 1907. A condition is that Edwin Rodakowski, a member of the club, must be given three weeks' notice of an intended attempt to compete, and that the date selected must not clash with any date of racing fixtures. Accommodations for aeroplanes wishing to compete will be provided free of charge.

It has been decided in addition to the above stipulations that the airship must cover the three miles of the course in not less than eighteen minutes, or at the minimum speed of ten miles per hour.

The track, or a portion of it, will be placed by the club at the disposal of those who wish to experiment on certain days in each month, beginning probably in May next.

Prizes for model aeroplanes weighing not over 50 pounds have been offered by the Aero Club of Great Britain for a competition to be held the first part of April. These machines must be able to fly a short distance under their own power. The first prize is $750, and there are two other prizes of $500 and $250 each.

Among the prizes offered for aeroplane flights abroad is a new $40,000 prize for a flight or race from Ostend to Paris. This prize was recently offered by the manager of the Ostend Kursaal, and it is open to both aeroplanes and dirigible balloons. Sunday, the 10th of August, is the date set, and all Sundays in succeeding Augusts till the prize is won. The distance is about 175 miles, and it must be covered within twenty-four hours.

SCIENCE NOTES.

The soapberry tree, *Sapindus marginatus utilis*, has been quite extensively cultivated in Algeria for its berries, which are rich in saponin, and are sent to Germany for use in the manufacture of soap. Similar qualities are possessed by the Florida soap tree, *Sapindus manatensis utilis*, commonly known as the China soap tree, from the fact that it was originally introduced from China. Mr. E. Moulie, of Jacksonville, Fla., has recently been engaged in promoting the cultivation of this tree in the Southern States by a free distribution of seeds. The tree grows to a height of forty or fifty feet and begins to bear fruit in the sixth year. The berries are about the size of cherries and consist of a hard, yellow-brown wax-like shell, inclosing a large black seed. The shell is rich in saponin, and if bits of it are agitated in water a lather will at once begin to form. By grinding the shells a brownsh soap powder is obtained which possesses valuable cleansing properties. The hard, black seeds of the soapberry tree have been used in the manufacture of beads; they also yield a fine oil useful in soap manufacture, as well as in other industries.

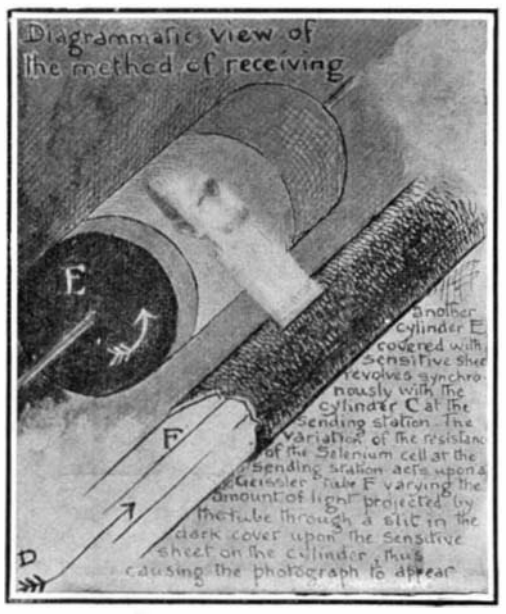
As the London Exhibition of 1851 was the time in the middle of the century when technical education began, so the World's Columbian Exposition at Chicago in 1893 marks the beginning of that educational technical movement of which we are now a part. During the last decade advancement has been phenomenal and the demand for technical education never was so great as at the present time. Never has greater attention been given to the subject. England is thoroughly alarmed at the possibility of losing her commercial supremacy. At the organization of the Municipal Technical School of Manchester a committee was sent to the Continent and another to this country to investigate the subject of technical education. Besides individual educators and members of Parliament who have come here, the Mosely delegation of thirty British workmen made an exhaustive study of the industrial situation and technical education. Educators from Norway, Sweden, Russia, France, Switzerland, and Germany have also been attracted to the United States by the remarkable progress we have made. While the presidents of literary colleges are spending much of their time in "stumping" the country, like so many politicians, advertising the advantages of their colleges and making frantic efforts to increase their attendance, the enrollment of the technical schools has been steadily increasing, without pomp or bluster, more rapidly proportionately than the enrollment in high schools, colleges, or universities, and even faster than population. In the South there is clearly apparent an awakening sense of the necessity of more technical skill to develop her resources. The introduction of textile schools, and the application of technical arts in the education of the negro are only forerunners of a great movement for more extended work in other lines. The farmer in the West has learned that the agricultural schools and experimental stations connected with the State universities are of an economic advantage to him and his sons. Mining industries have found that schools of mining engineering, located at convenient centers, are beneficial in supplying their need of trained engineers and metallurgists. The increase of manual training schools in all parts of the country is so rapid that it is difficult to find a supply of well qualified instructors. During the past decade the technical school in the United States which has not largely increased its enrollment, its equipment, and buildings, is decidely the exception. This tendency toward technical education is full of meaning to those who are studying the industrial development only in the educational aspect of the movement.

KORN'S PHOTOGRAPHIC FAC-SIMILE TELEGRAPH.*

BY ROBERT GRIMSHAW.

The following information was obtained in an interview with Prof. Korn, of Munich, the inventor of one of the latest systems of electro-telephotography, or of reproducing electrically, at a distance, photographic images.

As far back as 1901 the professor made more or less successful experiments in transmitting electrical-


Diagrammatic View of the method of receiving
E
F
D
Another cylinder E covered with sensitive sheet revolves synchronously with the cylinder C at the sending station. The variation of the resistance of the Selenium cell at the sending station acts upon a Geissler tube F varying the amount of light projected by the tube through a slit in the dark cover upon the sensitive sheet on the cylinder, thus causing the photograph to appear

The Receiver of 1903.

D. Wire from transmitter; F, Geissler tube; E, cylinder with film for receiving the image.

ly to a distance, simple figures and signs, by means of specially-constructed sending and receiving apparatus. The picture to be transmitted was placed in a glass cylinder which was constantly rotated and also simultaneously moved in the axial direction, and which was illuminated by light rays passing through a small opening in a metal casing surrounding the glass cylinder. The source of light was a Nernst incandescent lamp, the rays from which were totally deflected by a prism on to a selenium cell, which has the property of changing its electrical conductivity under the action of light rays of varying intensity. The more strongly the cell is illuminated, the greater becomes its electric conductivity, and *vice versa*. In the receiving apparatus, which was electrically connected with the sender by a telegraphic or telephonic line, the occurrences were similar to those in the sender. The light, which varied in its intensity, was admitted through a small opening in the casing of a glass cylinder containing a sensitive photographic film, and which had axial and rotatory movements similar to and synchronous with the cylinder on the sender. This effected on the sensitive receiving film a reproduction of the picture on the photographically fixed film in the sender. The greater the intensity of the electric current received, the greater the light emitted by the electric incandescent lamp of the receiving apparatus, and *vice versa*. The most important operation here was the absolute synchronism of the two cylinders—that of the sender and that of the receiver.

Whereas with the earlier apparatus a picture 5.2 inches by 7.2 inches could be electrically transmitted and photographically reproduced in about 15 minutes, recent improvements have reduced the necessary time for transmission and reproduction to from 6 to 12 minutes only; and as far as shortening the time for transmission is concerned, there seems at present to be no limit.

The recent improvement is in the direction of doing away with, or of neutralizing, the undesirable property of selenium, that it is not only sensitive to varying intensities of light in its electric conductivity, but is also affected thereby in its resistance. The combating of this undesirable property is effected by a compensator, in the shape of a second selenium cell in the receiver, that has the same degree of sensibility to light and corresponding conductivity to electricity as that in the sender, and its mate in the receiver, but in the opposite direction, so that in its variations, no matter how long they may continue, it practically counteracts all error, and thereby obviates delay. In this manner, as well as by replacing the former needle galvanometer by one of the chord type, it is possible, first of all, to shorten the time required for transmission, and in the second place to obtain, furthermore, much clearer pictures in the receiver.

The times given as necessary for transmission are naturally only for overhead conductors. Such rapidity is not attainable with submarine cables, by reason of their greater capacity.

The professor exhibited two pictures, one of the German Kaiser and one of himself, that at a distance of a yard were hardly to be distinguished from ordinary photographs, and which, the professor stated, had been transmitted through a resistance corresponding to 1,800 kilometers, about 1,080 miles.

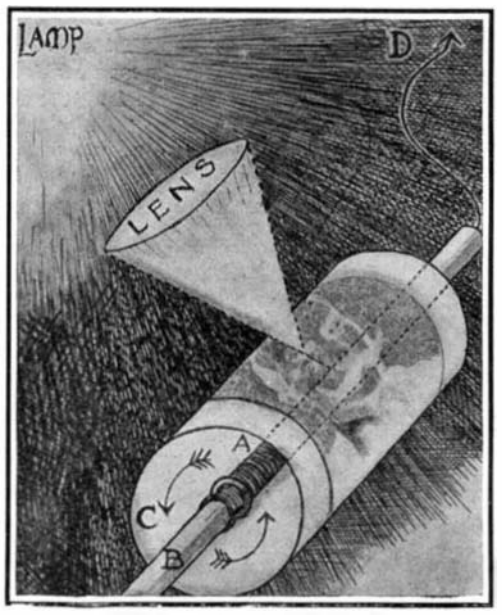
As regards the practical utilization of the invention, the professor stated that its application for purposes of crime detection would prove of the greatest value. The illustrated press has also naturally shown a great interest in the invention, and some of the European publishers have already made arrangements to use it. L'Illustration of Paris has purchased the sole rights for France up to July 1, 1909, after which these rights will revert to the inventor. That journal has the right to install sending apparatus in every country, and a receiver in Paris. The apparatus may be made by French manufacturers. For Germany the inventor has reserved all rights, and the apparatus will be made by a German firm. English journals show special interest in the matter, and both the Daily Mail and the Illustrated London News have taken steps toward the purchase of the English rights, but up to date the inventor has closed no contracts with them, in the expectation that an international company will shortly be formed.

When the German Kaiser was in München, Prof. Korn had made preparations to show him the apparatus and its workings; but the directors of the German Museum decided that the time would be too short, and the exhibition was not made. But the Kaiser manifested much interest therein, and ordered Prof. Slaby to give an explanation of the apparatus and its manner of working; this the latter did on November 27. In Paris, on the 3d of December, Poincaré read a paper on the subject of the selenium compensator and the new method.

In the spring there will be installed in Berlin and in some other important city, at a considerable distance therefrom, the apparatus for demonstrating on an actual working scale not merely the possibilities but the absolute practicability of the invention.

We illustrate herewith the really extraordinary results that Prof. Korn has obtained. As said before, the possibility of this remarkable electrical mechanical feat is due to a peculiar property of the metal selenium which can translate variations of light into concomitant variations of an electric current. Just as the diaphragm of a telephone causes the mechanical vibrations of sound to be reproduced in corresponding electric vibrations, so the action of variable light upon a plate of selenium, through which a current of electricity is passing, will cause that current to vary in exact accordance with the gradation of the light modified by a photographic film.

The apparatus will be best understood from the accompanying diagram. Like a telegraph or a telephone, there is at one end a transmitter, at the other end a receiver. In its simplest form the receiver consists of an outer metallic cylinder, and an inner cylinder of glass, on which is fixed the photographic film to be transmitted. The inner cylinder is made to revolve, and as it does so it passes an aperture in the metal cylinder, through which comes a focused beam from a Nernst lamp. This beam passes through the photographic film and thence to a prism, from which it is deflected to a plaque of selenium in the electric circuit. The variations of the revolving image are thus made to play upon the selenium, and are reproduced in the



The Transmitter of 1903.

A. Selenium cell; B, axis; C, glass cylinder carrying photo-film to be sent over the wire D.

electric wave passing through the selenium. The receiver consists primarily of a camera in which is another revolving cylinder carrying a sensitive film which is to receive the image. Through an aperture in the end of the camera comes another beam from a Nernst lamp which has previously been focused upon a Geissler tube. The tube (*G* in the diagram) is in the electric circuit, and the variations of the current are thus retranslated into variations of light, which, playing upon the sensitive film, set up the second image.

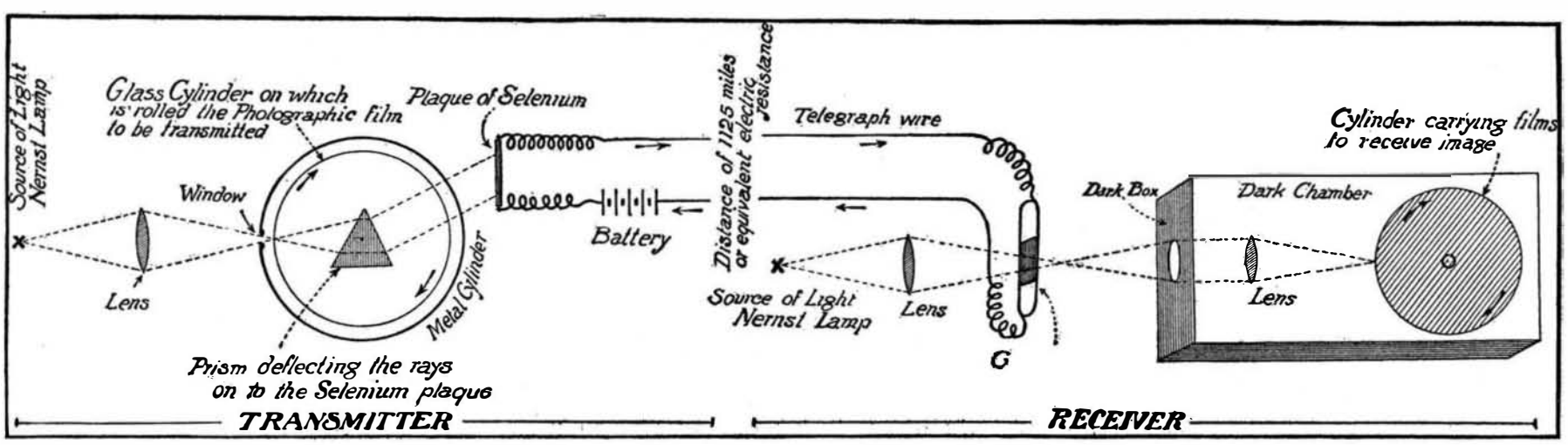


Diagram Showing the Working of Prof. Korn's Latest Apparatus for Transmitting Photographic Images.

A PHOTOGRAPHIC FAC-SIMILE TELEGRAPH.

* The pictures on this page are reproduced by courtesy of the Illustrated London News.

The period from 1840 to 1850 witnessed the establishment of commercial grape culture in the United States. A beginning was made in the manufacture of choice wine from American grapes on the Atlantic coast, the choicest Vinifera varieties were introduced on the Pacific coast, and wine made therefrom showed the pioneers of California that they could at no distant date enter into direct competition with Europe in the production of the choicest wines on the globe. It is to be regretted that so many of the fine wines produced have been sold under foreign labels of late years, there being but few of the better firms that have striven to make a reputation on their choicest wines, and the catering of the heaviest distributers to the cheaper trade has resulted in eliminating, to a very great extent, the growing of the better, less productive varieties of grapes; hence, a tendency toward producing quantity at the expense of quality. In 1850 the country produced 250,000 gallons of wine. In 1860 the product had reached over 1,500,000 gallons, and all the States and Territories, except four, were growing grapes. The census of 1860 showed California, New York, and Ohio as the three leading wine-producing States. From 1860 to 1875 rapid progress was made. In 1870 Missouri produced more than any other State except California. With this exception, California, New York, and Ohio have been in the lead. According to the last United States census (1900), twelve States reported having over 2,000,000 vines each in bearing.

THE CAR FERRY TRAFFIC OF LAKE ERIE.

BY W. FRANK M'CLURE.

Winter navigation on Lake Erie between the coal shipping ports of Ohio and Canadian harbors, 60 miles across, has long been a problem. For more than a decade, Lake Erie car ferries have attempted to run uninterruptedly the year round, but time and again in late winter are overtaken by ice conditions which result in their being frozen in for weeks, sometimes a mile or more from shore. Nevertheless the car ferry traffic of this notable inland body of water is a success and is increasing. A new ferry, with novel features for ice battling, of which great things are expected, has recently been put into service, and it is reported that another large ferry is to be built next year.

The navigation season for ore vessels on the lower lakes closes during the early part of December. After this time business at the docks is suspended except for the loading of ore from stock piles into railroad cars bound for the furnace districts, and the loading of coal, steel, and other freight to the car ferries. There is a constant demand for American coal on the Canadian side and, as to the supply, it is more plentiful in winter for these routes than in summer, when large numbers of vessels are waiting for cargoes for the upper lakes.

One of the car ferry routes of Lake Erie extends from the port of Conneaut, Ohio, to Port Dover, Canada. Other Canadian ports which are reached from Conneaut are Port Stanley and Rondeau. The latest route on Lake Erie is one which has been inaugurated during the past year between Ashtabula, the world's greatest ore receiving port, and Port Burwell, in the Dominion. Any of these routes compares favorably in length with the notable ones of Lake Baikal, which connect with the Trans-Siberian railway.

The first two ferries introduced on Lake Erie were each 300 feet long, 54 feet beam, 60 feet high from keel to deck, and equipped as 3,500-horse-power ice crushers. The number of cars which could be placed aboard was from 26 to 30, depending on the size of the cars. The ice crusher, located at the bow and shaped something like a spoon, climbs up onto the ice in its path and crushes it down.

In 1904, another type of ferry—the "Marquette & Bessemer No. 1"—was placed on a coal route between Conneaut and Rondeau. This boat is not a car ferry in the strict sense of the word, since, while the cars are run aboard *via* two tracks, they are not carried across the lake but discharge their contents from hopper bottoms into a continuous hatch over which the tracks are suspended. Ten cars at one time can be unloaded in this manner. The capacity of the hold is 2,500 tons. At the Canadian terminal four grapple unloaders remove the cargo in eight hours. The time of unloading, of course, is much longer than that of a ferry which carries the loaded cars, but the load carried is several times as great and the time of loading is but little more than that of the regular car ferries. The length of this vessel is 255 feet, depth 22 feet, beam 43 feet.

The new car ferry "Ashtabula," for which this is the first winter, is notable especially for her water bottom, which is so controlled that she can free herself from the ice in several different ways, dependent upon the kinds of ice with which she has to battle, or other conditions. There are eight transverse bulkheads, six of which run to the car or main deck and two to the lower deck. The water in the compartments is controlled by ballast pumps. Simultaneously one pump may be pumping the water out of one compartment and another pumping into another compartment. By filling the tanks aft and pumping out the ones forward, the ferry's bow is made to climb up on to a field of ice and crush it down in its path. To plow directly into a field of ice, when traveling light, the vessel is lowered to the desired depth by filling all the water compartments. Again, in freeing herself from ice, it may be deemed best to list the ferry to one side. This is accomplished by filling the tanks on one side of the ferry and pumping out those on the other.

This ferry is 50 feet longer than the ones on the Conneaut-Port Dover line heretofore referred to, and has a 56-foot beam. Her keel is 330 feet, her depth 20 feet. She is propelled by twin screws, driven by two triple-expansion engines with cylinders 19½, 31, and 52 inches diameter by 36-inch stroke, supplied with steam from four Scotch boilers.

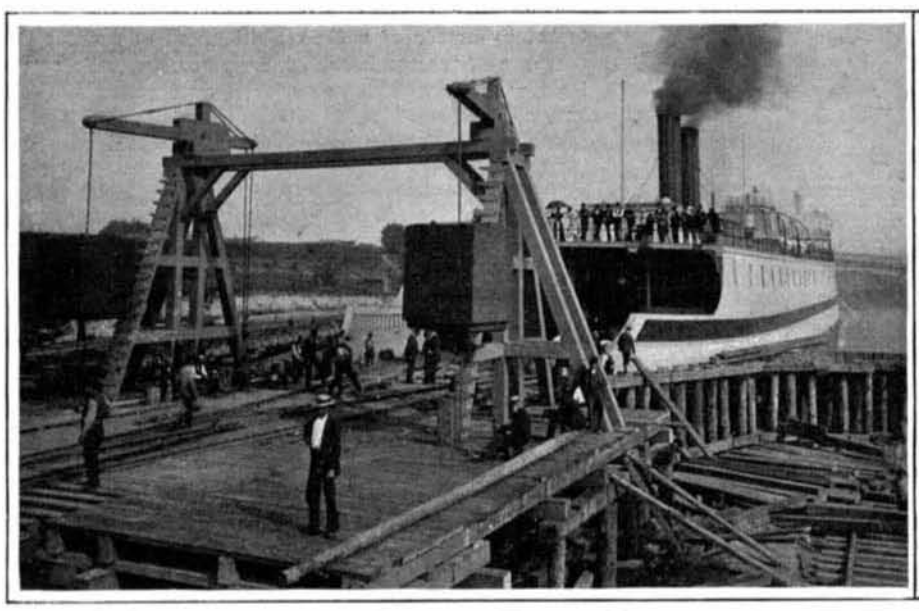
On board the car ferry "Ashtabula" there are four tracks. These tracks will accommodate thirty 50-ton cars coupled together and then fastened to bumper posts. New cars have been built especially for this ferry traffic. They are each 38 feet long.

In a cabin amidships are the galley and the eating quarters of the ferry. The dining room for officers and guests is elaborately furnished. There are also baths, lavatories, and all modern conveniences. Even the quarters of the deck hands are equipped for comfort. The vessel is lighted by electricity and, when in port, is connected with the telephone service. She was built at the yards of the Great Lakes Engineering Company at Detroit.

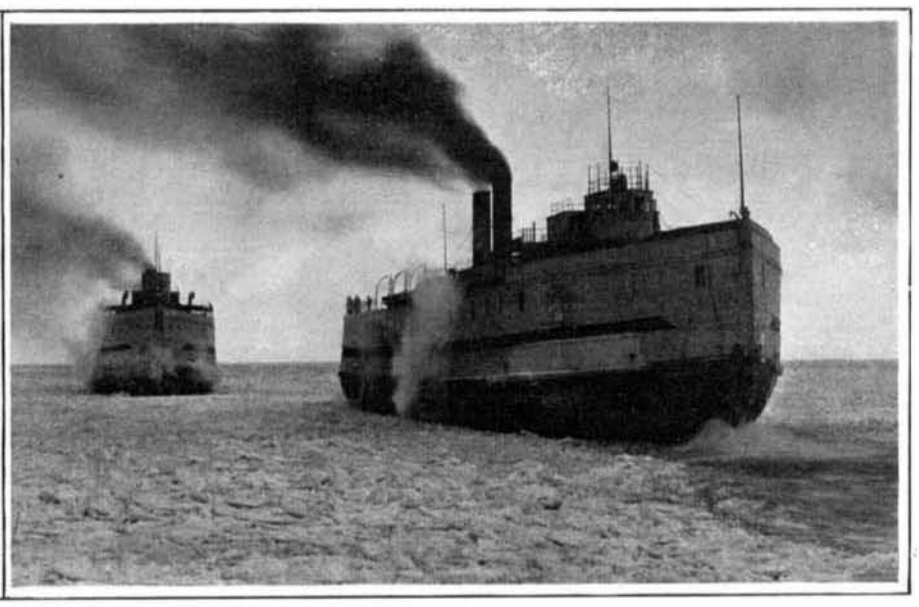
The ferry can make two trips a day between Ashtabula and Port Burwell. Her actual running time for the round trip on her official test was nine hours and twenty-five minutes. Going to Port Burwell with a full load of thirty cars of coal, and with the lake quite rough, she made a little more than 15 miles an hour and returning averaged 15¼ miles per hour.

The method of loading and unloading a car ferry calls for an apron which can be raised and lowered, and which is equipped with tracks which will connect the tracks of the docks with those on board the ferry. This apron hangs from powerful balance arms, from the opposite ends of which are counter-weights aggregating 40 tons. This lift is controlled by electric machinery. With the touch of a lever, the outer end of the apron can be raised or lowered to the level of the vessel's dock, the inner end working on rockers. The apron at the Ashtabula car ferry dock weighs 75 tons and is 30 x 52 feet in size. There are usually four tracks on the dock, four on the ferry, and two on the apron. The cars go to and from their respective tracks by switching. Two of the tracks in the car ferry yards are kept for empty cars and two for loaded cars. The switching of loaded cars aboard and empty cars to shore may progress at the same time. At the Canadian terminals, when switched to the docks, the cars are picked up by the Canadian railways and distributed to distant destinations for unloading.

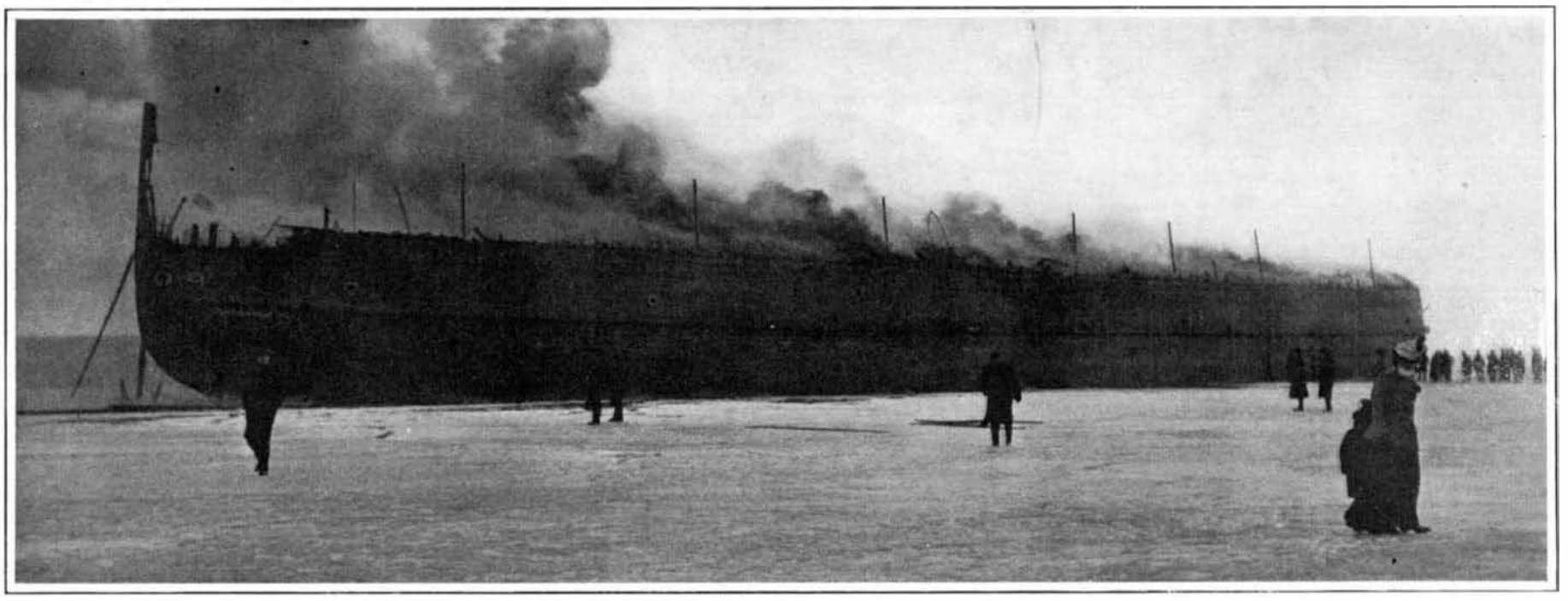
Lake Erie car ferries in starting out upon a one-day trip, in January and February especially, take with them a stock of provisions sufficient for at least three weeks. This is to provide for an emergency in case the ferry is frozen in on the route. When frozen in, members of the crews often walk to and from the mainland over the fields of ice. It was while thus stuck in the ice that the destructive fire shown in the accompanying photograph took place off Conneaut. This was some two years ago. The ferry burned was



The Apron of a Car Ferry Dock, Showing Counterweights Used in Its Operation.



Car Ferries Crossing Lake Erie Through Fields of Ice.



A Burning Car Ferry Caught in the Ice Off Conneaut Harbor.

THE CAR FERRY TRAFFIC OF LAKE ERIE.

"Shenango No. 1," which ran between Conneaut and Canadian ports.

The wind has a great deal to do with the ice conditions, often piling the ice up mountains high in the ferries' path. In such cases, if an opening can be found in the windrows, the ferry may break through. Otherwise, dynamiting is sometimes done with good effect.

THE BATTLESHIP OF THE FUTURE.—II.

BY FORREST E. CARDULLO.

(*Continued from page 133.*)

In the case of large guns, the most effective caliber of weapon is the minimum caliber which will give the requisite penetration at probable battle ranges. The greater the weight of a gun, the less the number of hits which it will score in a given time. The greater the weight of a gun, the less the number of them which can be carried on a given displacement. Two shells of 1,000 pounds weight each will have more destructive effect than will one shell of 2,000 pounds weight, provided that they have sufficient penetrative power. From these several considerations, it becomes apparent that a large number of guns of sufficient caliber are much to be preferred to a smaller number of larger guns.

There is reason to believe, however, that the weights of projectiles of given calibers will be increased. If a number of projectiles of different weights be fired from the same gun with the same powder charge, all will have the same muzzle energy. The lighter ones will have the higher initial velocity, the greater penetrating power, and will experience the greater air resistance. On account of this resistance, the velocity, the striking energy, and the penetrating power of the lighter projectiles will fall off much more rapidly than is the case with the heavier projectiles, so that at the longer ranges, the advantage lies entirely with the latter. Let us take for example a 12-inch gun firing 800, 1,000, 1,200, and 1,400-pound projectiles, as shown in Table I. At the muzzle, and at 3,000 yards range,

TABLE I.

Length of gun, 50 calibers. Powder pressure, 21 tons per sq. inch.

Range, yds.			Zero.		3,000		6,000		9,000		12,000	
C.	G.	S.	V.	P.	V.	P.	V.	P.	V.	P.	V.	P.
12	65	800	3600	33.6	3030	25.8	2520	20 0	2060	14.6	1670	11.0
12	65	1000	3220	31.6	2790	25.2	2390	21.0	2030	15.2	1720	12.6
12	65	1200	2940	30.0	2600	25.0	2280	21.0	1990	16.7	1730	13.8
12	65	1400	2720	29.0	2440	24.5	2180	21.0	1940	17.4	1720	14.5

TABLE II.

Length of gun, 60 calibers. Powder pressure, 17 tons per sq. inch.

8	23	300	3160	19.5	2540	14.4	2010	10.4	1560	77.2	1222	5.8
10	45	580	3160	25 5	2670	20.0	2230	15.0	1840	11.5	1510	9.0
12	78	1000	3160	30.5	2730	24.6	2340	19.0	1990	15.6	1680	12.0
14	124	1600	3160	35.6	2790	29.5	2460	24.5	2150	19 0	1870	16.3
16	185	2400	3160	41.0	2840	35.6	2540	26.6	2260	24.8	2010	20.8

Length of gun, 50 calibers. Powder pressure, 27 tons per sq. inch.

8	23	350	3300	24 0	2760	18.4	2260	13.6	1830	10.0	1480	7.2
10	45	700	3300	30.0	2860	24.2	2460	19.3	2100	15 2	1780	11.9
12	78	1200	3300	36.0	2940	30 0	2590	25.2	2280	20.4	1990	17.0
14	124	1900	3300	42.0	2980	36.0	2680	30.7	2400	26.0	2140	22.0

In these tables C represents the caliber of the gun in inches, G the weight of the gun in tons, S the weight of the shot in pounds, and V and P the velocity in feet seconds, and the penetration of Krupp armor in inches respectively at the range given.

the lighter projectiles have the higher velocities, and the greater penetrations. At a little less than 6,000 yards range, all the projectiles have practically the same penetration, but the lighter ones are preferable, since they give the flatter trajectory, and will also score more hits for a given weight of ammunition carried. At 9,000 and at 12,000 yards range, it may be seen that the 1,000-pound or the 1,200-pound projectile is preferable, the greater penetration of the latter being offset by the flatter trajectory of the former.

A comparison for all the ranges shows that the 1,200-pound shot gives the best average results, and is the one that should probably be adopted for this particular caliber and muzzle energy. For a greater muzzle energy, both the weight of the shot and the muzzle velocity should be increased, if we are to secure the most effective service from the gun. It may be stated as a general rule that the weight of projectile should be so adjusted to the caliber and power of the gun that the remaining velocity at the longest probable battle range shall be a maximum. This principle will necessitate an increase of from 20 per cent to 40 per cent in the weights of projectiles of given calibers.

Table II. gives the ballistics of two series of guns such as we may expect to see on the battleship of the future. An inspection of this table develops the fact that a 14-inch gun is probably as large as will ever be mounted on shipboard. The 16-inch gun weighs 50 per cent more than the 14-inch gun. Twelve 14-inch guns would be more effective than eight 16-inch guns, since they would fire twice as many aimed shots per minute, each of which is practically as effective as one from the larger gun. Both shells will penetrate any armor likely to be afloat for some time to come, at 9,000 yards range. The 16-inch shell has the advantage when employed against very heavy armor at more than 9,000 yards range, but this is not sufficient to counterbalance the advantages of the 14-inch shell at more practical ranges. Whether or not the 14-inch gun shall establish itself as the standard primary weapon is not clear from the table. The use of vanadium, or possibly some as yet undiscovered element, in the manufacture of armor may confer upon it such resistant qualities as to make the adoption of a 14-inch gun advisable, or changes in the propelling machinery may make the adoption of much thicker armor possible, but if neither of these possible events comes to pass, it is probable that the 12-inch gun will remain the most powerful naval weapon.

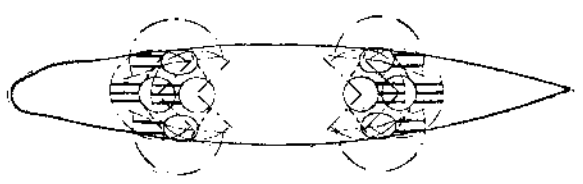


Fig. 7.—Twenty 12-Inch Gun Battleship. Two Groups, Each Containing Two 3-Gun and Two 2-Gun Turrets.

The proportion of weight which the modern designer devotes to armor is about 25 per cent. On the battleship "Connecticut" this gives us the equivalent of 12-inch armor over the vital parts of the ship. If the proportion of weight and distribution of armor remains the same, the thickness of the armor will vary as the cube root of the displacement. We should therefore expect a 20,000-ton ship to have 13 inches of armor, a 25,000-ton ship 14 inches of armor, and a 30,000-ton ship 14¾ inches of armor. None of this would be safe against guns of 10-inch caliber or over, at 6,000 yards, and the tendency will be to thicken it when possible. This may be done either by increasing the proportion of weight devoted to armor, or by reducing the area of the thin armor covering the non-vital upper works. The last method is far the best. If we increase the proportion of weight devoted to armor, it must be done at the expense of gun power. Any armor that can be made can be penetrated at some range, and our heavily armored ship may be attacked by a ship of thinner armor and superior gun power, and destroyed at short range where its superior armor is useless. At the same time, armor is necessary, for if a ship be unarmored, it would be quickly destroyed at long range by an armored vessel, while its own guns were powerless to inflict damage. There is a golden mean in the matter of the thickness and extent of armor carried, which will give the most powerful ship for the given displacement, and it will probably be found somewhere about as indicated in Table III.

TABLE III.

Displacement, Tons.	Armor Thickness, Inches.	Speed, Knots.	Displacement, Tons.	Armor Thickness, Inches.	Speed, Knots.
12,000	12.7	18.0	30,000	17 2	20.0
16,000	14.0	18.6	35,000	18.2	20.4
20,000	15.1	19.1	40,000	19.0	20.8
25,000	16.3	19.6			

In arranging the distribution of armor, the principle to be observed is to protect all of those parts of the ship whose integrity is essential to her fighting power, by armor of the greatest practicable thickness, giving all these parts substantially equal protection. The center of the ship constitutes a steel-walled fortress within which are assembled the boilers, engines, magazines, and other vital machinery and stores. In Fig. 8 are shown the midship and longitudinal sections of the ship shown in plan in Fig. 7. It will be seen that the walls of vertical armor constituting this fortress are about 12 inches thick above the water line, and taper to perhaps 9 inches thick at the lower edge, some six or eight feet below this. Meeting this lower edge is a sloping deck from 2½ inches to 4 inches thick, which becomes horizontal when it has risen to the same vertical height as the top of the armor belt. The end walls of the fortress, which are known as the armored bulkheads, are of about the same thickness as the side walls, but are protected by the armored deck, instead of protecting it. Thus any shot entering this central fortress must first penetrate two thicknesses of steel, one or both of which it must strike obliquely. If the projectile be a shell, the first thickness of armor will explode it, and the second thickness will effectually prevent the pieces from entering any vital spaces. The only projectile which can penetrate will be the comparatively harmless solid shot.

From the armored roof of this fortress rise the barbettes or citadels which form the supports for the gun turrets. The thickness of the armor inclosing these supports, and the ammunition hoists and gun mountings contained in them, will be about 16 inches in the case of the ship we are considering. The armor on the faces of the turrets will be of about the same thickness, while the sides and backs, being in general turned away from the enemy, will be thinner.

The entire water line of the vessel should be protected by armor of sufficient thickness to prevent the entrance of "common shell," a type of projectile carrying a very heavy and destructive bursting charge. This belt will have to be 8 inches thick if it is to oppose 14-inch guns, since common shell will pierce half its caliber of armor. There are a few other parts of the ship which it may be advisable to protect from shell fire, but in general the same principle holds in the case of armor as with guns, namely, that all armor should have the same resistance to penetration, just as all the guns should have the same penetrating power.

Besides the rifled gun, the only practical weapon of offense known to naval warfare is the torpedo. If two fleets of equal cost engage each other, the fleet of smaller and more numerous vessels will have the advantage in torpedo warfare. It will, however, be at a disadvantage with respect to gun power, armor, speed, and coal endurance. Since the vast majority of naval battles are decided by gun fire, the advantage will in general lie with the larger ships, but the possibilities of torpedo warfare will always act to prevent a further increase in the size of ships, if there is any doubt that the increase in size will confer a more than proportionate increase in power and efficiency. It is entirely possible that sufficient improvement may be made in the design and operation of torpedoes to throw a very decided advantage on the side of the smaller and more numerous ships, in which case the tonnages of the present may be adhered to for the future, or even reduced. This is a matter which can only be decided by pushing to the limit the development of torpedoes.

To have such an effect on the size of our future battleships, a torpedo must be designed with an effective range nearly equal to the effective range of the guns carried. It is not sufficient that the torpedo should run merely the distance indicated, but its speed and accuracy must be such that there shall be a reasonable percentage of hits, and its power must be sufficient to inflict a great deal of damage. Mechanically, it is possible to construct a torpedo of sufficient range and power, but the chances of a hit are very slim, unless used against a disabled ship, or a large fleet maneuvering in certain formations. We may construct a torpedo two feet in diameter and twenty feet long to carry 500 pounds of high explosive at a speed of 50 knots or more, and to execute any assigned course over a given area. If the course of a distant hostile fleet could be predicted for say eight or ten minutes ahead, it would be possible to have fifty or one hundred of these terrible engines of destruction continually circling in the waters over which the fleet would pass. Such a development of torpedo warfare would certainly affect naval tactics, and probably, battleship design.

No protection that we know of at the present time will avail against the torpedo if the size and cost of that weapon be sufficiently increased. To repel the attacks of torpedo boats, a battleship must be armed with a battery of from twelve to twenty guns of small caliber. It is evident that the effective range of these guns must exceed the effective range of the torpedo, that the caliber of the shell must be sufficient to destroy the torpedo boat before it has launched its bolt, and that the rate of fire must be very high. To obtain the requisite range and stopping power, a 5-inch gun is necessary, and to obtain a sufficient rapidity of fire to make such a defense effective against a simultaneous attack by several boats, the operation of the gun should

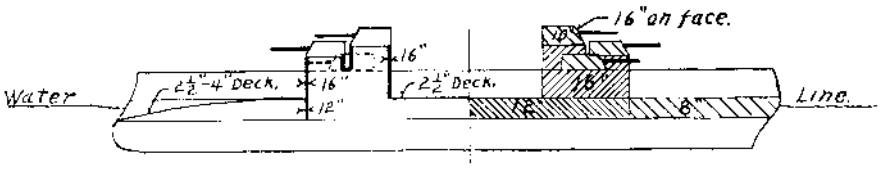


Fig. 8.—Longitudinal Section Showing Disposition of Armor.

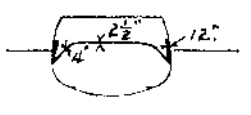


Fig. 8a.—Midship Section Showing Relation of Protective Deck to Belt Armor.

THE BATTLESHIP OF THE FUTURE.—II.

be as nearly as possible automatic. Such a gun would require a large supply of ammunition, and powerful ammunition hoists, on account of the rapidity of fire. A battery of such guns would perform many of the functions in battle for which the secondary battery was originally designed, the most important being the attack of unarmored and lightly armored vessels, such as scouts, cruisers, and destroyers.

The speed of battleships will probably be subject to less variation than any other characteristic in the future. The speed of modern types of hulls may be represented very accurately by the formula

$$S = 6.35 \sqrt[3]{H.P. \div D^{\frac{2}{3}}}$$

where S is the speed in knots, $H.P.$ is the horse-power of the engines, and D is the displacement in tons. Designers seem at present to be of the opinion that the best results are obtained in the matter of all-around fighting efficiency by allowing 1 horse-power for each ton of displacement. This gives for various sizes of ships the speeds noted in Table IV.

The speeds may be made somewhat higher than this by increasing the engine power at the expense of armor, guns, economy, and cruising radius. It is not likely that they will exceed the speeds given by more than a few per cent, since these speeds, particularly for the larger ships, are amply sufficient for all strategic purposes. Tactically, additional speed confers no advantage that is not had more cheaply from heavier armor and armament. Of course the faster ship may theoretically choose her position and range, but if she is overmatched in guns and armor at all ranges, her only choice is to run.

We may therefore conclude that the speed of the battleship of the future will be kept down to the neighborhood of 20 knots, unless some radical change is introduced in her propelling machinery which will both lighten it tremendously and add at the same time to its efficiency. As a practical illustration of the cost of speed, let us take the case of one of the above-mentioned vessels, having 20,000 tons displacement, and 19.1 knots speed, and give it a speed of 24 knots. To do this, we must take 2,000 tons from the weight of its armor and armament, giving a reduction of over 40 per cent in its fighting power. In addition, we have increased the cost of maintenance of the vessel by about 25 per cent, and diminished its economical cruising radius in the same proportion. Even if we regard the 25 per cent increase of speed as producing a vessel of 25 per cent greater efficiency for the same fighting power, which is very doubtful, a fleet of such 24-knot ships will have only 60 per cent of the fighting power of a fleet of 19-knot ships costing the same money. While for certain purposes it may be advisable to build a few such ships, they will be by no means the most powerful and effective ships for their cost, and they will be of real value only in exceptional service demanding great speed.

Other things being equal, the further that a ship can travel without replenishing her coal, the more desirable she is. The greatest distance that a ship can travel without replenishing her bunkers is known as the coal endurance, the cruising radius, or the radius of action of the ship. This quantity varies for similar vessels as the cube root of their displacements, and for different types of engines inversely as the coal consumed per horse-power-hour at economical cruising speeds. The radius of action of the battleship of the future therefore depends almost entirely on the type and economy of the motive power.

So far as we know at the present time, there are three types of prime motors available as the propelling engines of warships: namely, the reciprocating steam engine, the steam turbine, and the producer-gas engine. Each one of these types has its own peculiar advantages which fit it for some particular service. The steam turbine has the advantage of freedom from vibration and also of extreme mechanical simplicity. The steam engine gives the best control of the ship when maneuvering, a matter of very great importance in naval warfare. The gas engine is the best of the three from the standpoint of economy of fuel and maintenance. Comparing these motors one with the other we find as follows:

In the case of the steam engine compared with the steam turbine, we find that for equal efficiency at all powers, they are of practically equal weight, since we require three turbines, called the cruising turbine, the backing turbine, and the main turbine, to perform the same service ordinarily obtained from one reciprocating engine. In addition to the matters of mechanical simplicity and freedom from vibration, the turbine is set low in the ship, and so is more easily protected than the steam engine. The steam engine is cheaper in first cost, is more easily repaired when injured in battle, and the ability to maneuver readily conferred by its use is a matter of very great moment in fleet actions. We may therefore conclude that while the steam turbine may be a preferable equipment for high-speed passenger ships and torpedo boats, it does not possess any great advantage over the reciprocating steam engine when installed in a battleship.

Comparing a gas engine using producer gas made from ordinary steam coal, with the steam engine, we will find that the total weight for a given power is practically the same in each case. It is possible to balance the gas engine more perfectly than the steam engine, but it will give more vibration than the steam turbine. By the use of compressed air for starting and reversing, the gas engine becomes as easily controlled as the steam engine. The gas engine will be set lower in the ship than the steam engine, but not so low as the steam turbine. In all other points, the gas engine is far ahead of either of the other types of motors, as will appear from the following considerations:

The efficiency of the gas engine in the matter of fuel consumption is twice as great as that of either of the other motors. This doubles the radius of action without any increase in the size of ship, a matter of great importance. The cost of fuel while the ship is in operation is only half of that for a steam-driven ship. The cost of maintenance also is very much less, since the upkeep of the producers is only a fraction of that of the boilers necessary in a steam-driven ship. The gas engine produces no smoke, which reduces materially the chance of discovery by the enemy, while the clouds of smoke belched from the funnels of a steam-driven vessel make its discovery an easy matter. In time of battle these same clouds of smoke and flame escape through the shot holes in the funnels and entering the gun spaces of the ship make the guns almost untenable, a condition of affairs which would not obtain in the case of a ship driven by gas engines. Should a shell penetrate the boiler room of a steam-driven ship, the damage to life and material would be enormous, and hours or days would be necessary to repair it. Should a shell penetrate the producer room of a gas-powered ship, the damage would be slight, and easily repaired, since the producers would be under suction, not pressure. Lastly, the producer-gas engine offers the combination of an economical motor of reasonable weight using coal as a fuel for low powers; and liquid fuel, which can be stored indefinitely in the double bottom of the ship, can be quickly gasified to greatly augment the power in case of emergency. Take for example a ship of 20,000 tons displacement. Equipped with engines of 30,000 horse-power, and producers of 10,000 horse-power, such a boat would have an economical cruising speed of 15 knots, and a very large radius of action. Should occasion arise, the more expensive liquid fuel would be instantly available to develop the entire 30,000 horse-power, giving her a speed of 22 knots. The whole weight of the apparatus would not exceed that of a 20,000-horse-power steam plant, and the ship would lose none of her effectiveness as a fighting machine.

We may therefore expect that the battleship of the future will be driven by producer-gas engines. The change will be slow to come, on account of the reluctance of both naval officers and naval designers to undertake to install or use anything so novel. In the substitution of any new and untried piece of apparatus for an old and tried one, the tendency is always to minimize its virtues and magnify its faults. Conservatism is practised to a grievous fault in all engineering work, more particularly that of a military or naval character. The gas engine will for this reason be slow in finding its place in the navies of the world, in spite of its many advantages, although its eventual adoption is certain.

In determining the displacement necessary to carry a given armament with the best efficiency, we will be guided by the following principles: First, that the total weight of the gun structures, including turret, barbette, loading gear, etc., varies as the square of the caliber when similar guns are in question. Second, that when guns of the same caliber differ in length, the total weight varies as the square root of the length. Although these principles are approximations, they are nevertheless very nearly true. We will, then, have for our displacement the formula

$$D = K N C^2 \sqrt{L},$$

where D is the displacement in tons, N is the number of guns if mounted in separate two-gun turrets, C is the caliber of the guns in inches, L is the length of the guns in calibers, and K is a constant to be determined by reference to existing designs. Taking the case of the "Dreadnought," we have for the value of K very nearly 1.90, which value we will use.

In Table IV. we have the tonnages of vessels carrying from eight to twenty guns of different calibers. The length, breadth, and draft there tabulated are found by multiplying the cube root of the displacement by coefficients found from existing ships. The speed and armor thickness have been taken from Table III. The cruising radius given is for steam power, and is found by the formula

$$R = 220 \sqrt[3]{D}$$

where R is the radius in knots and D is the displacement in tons. For gas-powered ships, the cruising radius would be twice the figure given, and the speed would be three knots higher. The cost given is that of the entire ship, armor and armament included, estimated at $470 per ton.

TABLE IV.

Arr. Number.	Caliber Guns, Inches.	Number Guns.	Displacement.	Length.	Breadth.	Draft.	‡ Speed.	§ Cruising Radius.	Armor Thickness, Inches.	Cost.	‖ Fighting Power.	Fighting Efficiency.
1	12	8	15 500	425	76	26½	18.5	5,500	13.5	$7.200,000	153	99
†1	14	8	21,000	470	84	29¼	19.2	6,100	15 5	9,900,000	282	134
2	12	10	19,500	460	82	28¼	19 0	6,000	15.0	9 200,000	181	93
4	12	12	23,400	485	90	30½	19.4	6,300	16.0	11 000,000	259	111
†4	14	12	32,000	540	100	33½	20.2	7,000	17.7	15.000 000	460	144
6	12	12	21,400	470	85	29½	19.2	6,100	15.2	10,000,000	266	124
†6	14	12	28 000	516	93	32¼	19.8	6,7 0	17.0	13,200,000	473	169
5	12	16	26,000	503	90	31½	19.7	6,500	16.4	12.200.000	308	119
*7	8	20	13,000	430	70	25	23.0	5,100	7.0	6,500,000	76*	59
*7	10	20	2 ,000	500	80	28¾	24.0	5,800	9.0	9,600,000	182*	91
7	12	20	29,000	525	94	32½	20.0	6,800	17.1	13,600,000	422	146
†7	14	20	39,000	580	104	36	20.8	7,5.0	19.0	18,300,000	750	192

* These two vessels are armored cruisers, not battleships.
† It will not prove advisable to build these vessels unless their armor shall be able to resist the attacks of the 12-inch gun at the longer ranges. Should the 12-inch gun be able to penetrate their armor, the efficiency given is too high, as is also the fighting power.
‡ For gas-powered ships the speed is three knots more.
§ For gas-powered ships the cruising radius is doubled.
‖ For gas-powered ships the fighting power and efficiency are each 25 per cent greater.

In the column headed "Fighting Power" will be found a factor representing for each ship the writer's idea of her fighting abilities. This is found by multiplying together the power of the arrangement in gun units, the cube of the gun caliber, the square of the cube root of the armor thickness, the speed, and the sixth root of the cruising radius. It is evident that the relative value of these various elements is very largely a matter of opinion. The writer has not ventured his own opinion in this matter, but has given instead the opinion of the majority of naval designers as expressed in their most successful designs. The fact that designers stop at 25 per cent of the displacement for armor protection, instead of increasing the proportion and so thickening the armor, shows their opinion of the value of a given thickness of armor as compared with any other thickness. The "Fighting Efficiency" given in the next column is the quotient found by dividing the fighting power by the displacement.

While forecasts of the future are always uncertain, and it is impossible to see how changed conditions will affect the design of battleships, it is nevertheless reasonable to assume that the increase in tonnage will go on at about the same rate as it has in days gone by. In general, the tonnage will be the maximum which the development of docks and harbor facilities will permit. These developments go on under the influence of unchanging economic law, and are not affected materially by new discoveries and inventions, unless indeed these discoveries and inventions are of such vital and far-reaching importance as to affect in unforeseeable ways all marine design, that of battleships included. We are therefore reasonably safe in predicting the size of future battleships for given epochs by the law of increase in past years. In 1875 the average tonnage of first-class battleships laid down by Great Britain was 9,500. In 1885 it was 11,000. In 1895 it was 14,500. In 1905 it was 18,000. The law of increase is roughly 25 per cent per decade. Assuming that the same rate of increase is to hold for the next thirty years, we will have in 1915 ships of 22,500 tons, in 1925 ships of 28,000 tons, and in 1935 ships of 35,000 tons.

The Death of Prof. Mendeleef.

Prof. Dimitri Ivanovitch Mendeleef, one of the greatest chemists in the world, died recently in St. Petersburg. He was born in Siberia in 1834, and when a young man went to St. Petersburg, where he received his education. In 1861 he became professor of chemistry in the Technological Institute in St. Petersburg and became famous, not only as a chemist and a teacher, but also as a geologist and philosopher. In a few years he succeeded to the chair of chemistry in the St. Petersburg University. His field of original research was wide, and in 1871 he foretold the existence and general properties of three new chemical elements now tabulated under the names of gallium, scandium, and germanium. He wrote many papers on chemical topics, and his book, "Principles of Chemistry," was reprinted in many languages. He received the Cowley gold medal at a meeting of the Royal Society in London last year.

Formaldehyde Useless as a Preventive of Frilling.

Photography states that the practice of adding a little solution of formaldehyde to a developer to prevent frilling is entirely without effect owing to the decomposition of the formaldehyde by the sodium sulphite which is a component part of practically all developers. This results in the liberation of sodium hydroxide and may cause fogging owing to an excess of alkali.

TOBACCO RAISING IN THE PHILIPPINES.

BY HAMILTON WRIGHT, SPECIAL COMMISSIONER IN THE ORIENT OF THE PACIFIC COMMERCIAL MUSEUM (WITH PHOTOGRAPHS BY THE AUTHOR).

Save for some little statistical information regarding the tobacco manufactories of Manila, less is known in America of Philippine tobacco than is known of it either in Europe or Asia. Nine-tenths of all the tobacco raised in the islands, and practically all that is used commercially, is produced in the vast Cagayan valley of central and northern Luzon, a region of which even many Americans in the islands have little first-hand knowledge. The valley is out of the general line of travel, and attention was not directed to it during the insurrection; its people were "pacificos."

Yet here is one of the most fertile valleys in the Philippines. Perhaps it is among the richest in the world. For a period of more than one hundred and forty years tobacco has been raised on the overflowed lands of the valley without artificial fertilization. It is the custom of the Cagayanes to raise one crop of tobacco and one crop of corn on the same land in one year. In two succeeding years two crops of tobacco and three crops of corn have been produced from the same soil. The Rio Grande de Cagayan, from which the valley takes its name, is the largest river in the Philippines. It is at once the Nile and the Mississippi of the archipelago. Rising in the Cordillera mountain range of central Luzon, the backbone, as it were, of the great island, the Cagayan flows north for a distance of 225 miles as the crow flies, until reinforced by many large tributaries, it at last empties into the China Sea at Aparri, the northernmost port of Luzon. The purple-peaked Cordilleras gradually widen to make way for the huge river, forming the east and west boundaries of a vast grassy plain almost two hundred miles long and with an average width of between thirty and forty miles.

Loading Baled Tobacco on a Scow.

Philippine Precocity in the Use of the Tabaco Grande.

The bulk of the tobacco in the Cagayan is raised like so much hay. Little attention is given to the details of curing and harvesting, which in the case of so intricate a crop demand both scientific and experienced treatment. Most of the good tobacco land is the overflowed land, which consists mainly of small pockets, belts, and patches, with occasionally greater areas of level land lying along the bed of the Cagayan River and its tributaries, and which doubtless formed the bed of the river at an early period. At the end of the rainy season during the latter part of December the northeast monsoon blows up the river from the China Sea, causing the water to rise, when a freshet occurs, as much as twenty feet in as many hours. It overflows the ground to a depth of two or three feet. With the lull of the wind in a few days this back-water recedes, and a heavy deposit of silt is left on the land. On the overflowed land tobacco is planted during the latter part of January or early in February, while on the high land it is planted several weeks earlier. In three months the plant has reached a height of from four to six feet. The leaves begin to get yellow in spots and curl back. It is ripe.

It is interesting to note how the native raises tobacco. Before transplanting to the high or the overflowed land, young tobacco plants have been grown thickly in a seed bed. When they are six or eight weeks old they are transplanted to soil which has been crudely scratched during the time of their growth by a carabao plow. The carabao covers but one-fifth of an acre a day. It usually takes three or four plowings to get the ground into condition for planting. The plow itself is a primitive affair made from the crotch of a tree. It goes but four inches deep, and moves so slowly that it does not "turn" a furrow. Such a thing as seed selection is unknown to the majority of natives. "Topping the plants," or nipping off the higher stems to force vigor into the leaves, is usually disregarded. Cutting off the "suckers" is seldom practised. After the tobacco is dried it is often strung under the dwelling among the pigs, chickens, and carabao. When the leaves are picked they are cured in the sun, but frequently are allowed to mold and mildew afterward, thus bringing them down to the fourth or fifth grade. It is the curing which largely determines the grade, and consequently, the price of the tobacco. Only the large plantations have curing sheds.

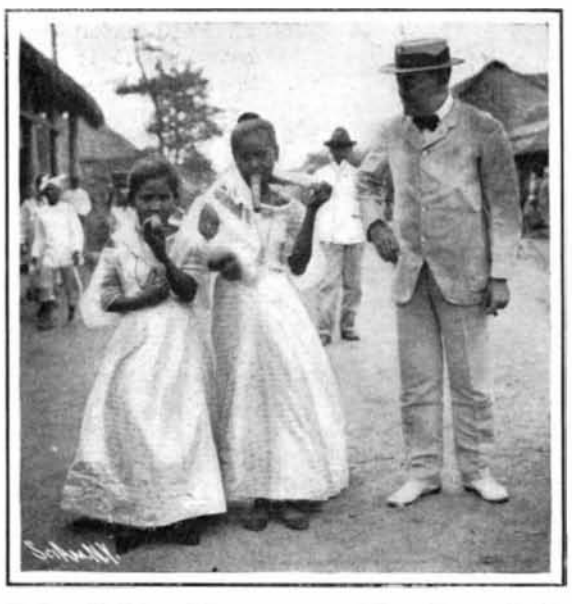
Despite the many drawbacks in cultivation and curing, a very fine grade of tobacco is produced in the Philippines. At the Hacienda San Luis of the Tabacalera Company some wrapper leaf is being raised under shade. Señor Orres, manager of the plantation, claims that it is not surpassed by any leaf tobacco in the world. Prof. Lyon, of the Insular Bureau of Agriculture, believes the Cagayan valley equal to the famous Vuelta Abajo district of Cuba. But most of the tobacco is of inferior grade. It is spoiled in the curing. Even with free trade with the United States it is doubtful if tobacco of fine grade will be raised in sufficient quantities to make it a formidable competitor in American markets. It will take years to educate the people to raise and cure it properly. One-fourth the present area in tobacco with greater attention would yield better returns than the present careless cultivation.

In contrast to the former government monopoly, today in the Cagayan the people own and control their own farms. In the province of Cagayan there is a population of 142,000, with 23,000 land owners. With five to a family, and excluding middlemen, it seems fair to assume that almost every farmer owns his own land. A similar condition holds good in the province of Isabella, south of Cagayan province, which includes the rest of the tobacco land. A very small plot of the best tobacco land is a small fortune to the natives. The average family lives by less than a hectare (2.47 acres) of land. The whole family helps in the work. Almost all of the working population of the valley is connected with the industry in some way or other. Though most of those engaged in tobacco production are small owners, there are half a dozen large firms operating in the Cagayan valley, the Spanish and German firms predominating. The largest corporation is the General Tobacco Company (Compañía General de Tabacos de Filipinos) which was established in 1882. Little actual capital, it is said, was invested in the undertaking, but to-day this company is without question the most powerful corporation operating in the islands, whose revenues are derived there. It is capitalized for $17,000,000 (gold) on which it pays generous dividends.

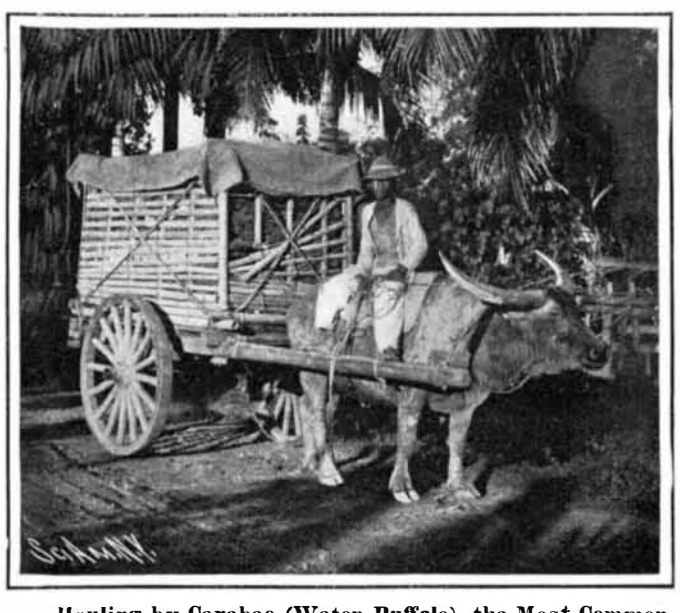
There is but one American company, the Philippine Plantation Company, in the valley. This company is deserving of notice here as the largest, and practically the first American agricultural corporation of any size that has actually cultivated the ground on an extended scale since the American occupation. The company purchased the old Maguidad estate of 44,000 acres, near Tuguegarao. It has erected modern buildings on the plantation, which is provided with the equipment of an up-to-date tobacco estate. Lieut. Schermerhorn, the manager, had a considerable area in tobacco this year, which was his first season. Next spring it is hoped to have a 5,000-acre crop, which will be the largest single planting in the valley. The future of this plantation will be watched with interest by the government experts and others who are anxious for the success of modern methods of agriculture.

Philippine tobacco is sold in thirty-five different countries. From Canton to Peking the most expensive and also most generally sold cigarette comes in a package of Manila tobacco put up in Austria. Manila cigars are the most popular in Japan and sell at 30 sen (15 cents American money) though the Japanese government itself maintains a tobacco monopoly. But the value of the Philippine tobacco crop sinks into insignificance when compared with the world's increasing supply and demand.* The value of the tobacco manufactured in the Philippines in 1905 is estimated at $5,494,627.† $892,561 worth of cigars and $14,250 of cigarettes, or a total of (manufactured tobacco) $906,811, and $1,374,892 of leaf tobacco (manufactured) was exported. $3,212,924 worth of manufactured tobacco therefore remained in the islands. Besides this a presumably enormous quantity of leaf of an inferior grade was sold or traded to natives of the Philippines, who often roll their own cigars before smoking. When manufactured in other countries the unmanufactured tobacco brings from thirty to fifty times its selling price.

The greatest consumers of Philippine tobacco are the Filipinos themselves. With a population of



Judge McCabe of Tuguegaro and Two Young Ladies Whom He Met in the Market Place One Sunday Morning as They Were Returning from Mass.



Hauling by Carabao (Water Buffalo), the Most Common Method of Transportation in the Philippines.

Loading Tobacco in a Banquelia for Shipment Down the River.

TOBACCO RAISING IN THE PHILIPPINES.

*In the United States alone 440,000,000 pounds of tobacco are consumed annually. Germany ranks next with a consumption of 201,783,000, Russia 150,244,000, France 84,393,000, United Kingdom 83,378,000.

† This estimate is, presumably, much lower than the actual amount of tobacco manufactured. When, for instance, for purposes of revenue the value of tobacco manufactured is classified at less than $25 and more than $10 per thousand cigars, for the purposes of this article the value has been taken at but $10 per thousand cigars.

over eight millions, practically all of whom, even the non-Christian tribes, are incessant smokers, usually including women and children as well as men, and with many districts where tobacco is not raised for family consumption, the consumption of tobacco must be many times the value of the export. In the Cagayan a most unique custom prevails among the women, who smoke a huge cigar, the *tabaco grande*, which reaches a length of from thirty inches to three feet and is several inches in diameter. These huge cigars are smoked off and on for a day and a half or two days. Sometimes a *tabaco grande* is suspended in the middle from a rafter in the dwelling, and all the women folk of the family puff in turn. The men smoke the cigarettes or the ordinary-sized cigar.

When the railroad projected through the heart of Luzon to connect Manila and Aparri is constructed, the tobacco industry will be immensely stimulated by the attention directed to the Cagayan. In the event of free trade the industry will profit not so much through enlarged markets in the United States (for there is always a demand for all good-class Philippine tobacco) as through the stimulus given to the importation of modern machinery and the feeling of encouragement given the islands generally.

Stevedores Posing for Their Pictures and Incidentally Getting a Breathing Spell.

A Rubberless Pneumatic Tire.

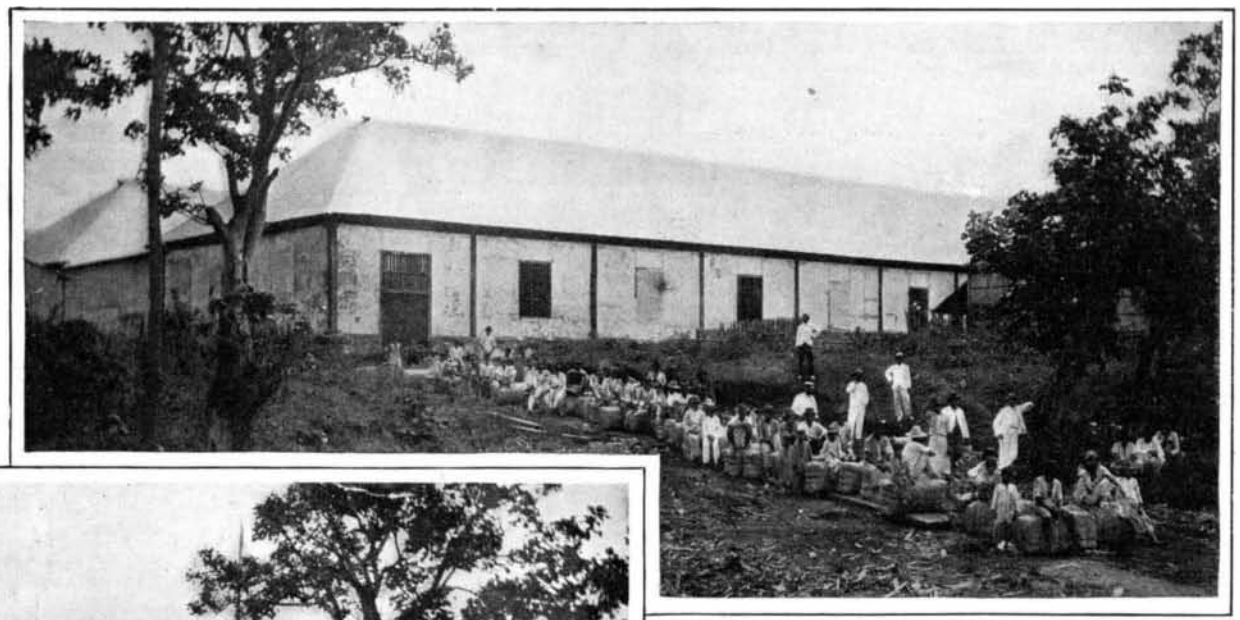
Experiments are being carried out in London upon a 15-horse-power automobile and a few heavy mechanically propelled vehicles with a new material that has been evolved as a substitute for pneumatic tires. As is well known, although the latter type of tires possesses great resiliency, conducing to complete comfort in riding, its liability to puncture is a decided disadvantage. In this new tire the resiliency of the pneumatic tire is retained as much as possible, while puncturing is completely obviated. "Elastes," as this new material is called, comprises a mixture (in predetermined quantities which vary according to the type of vehicle to be fitted, the nature of its traffic, and the roads upon which it is designed to ply) of three substances---glue, glycerine, and chromic salts. These are dissolved and mixed at a high temperature and while in the liquid condition are injected into the inner tube of the tire. The compression of the material and consequently its density also fluctuates according to the foregoing conditions.

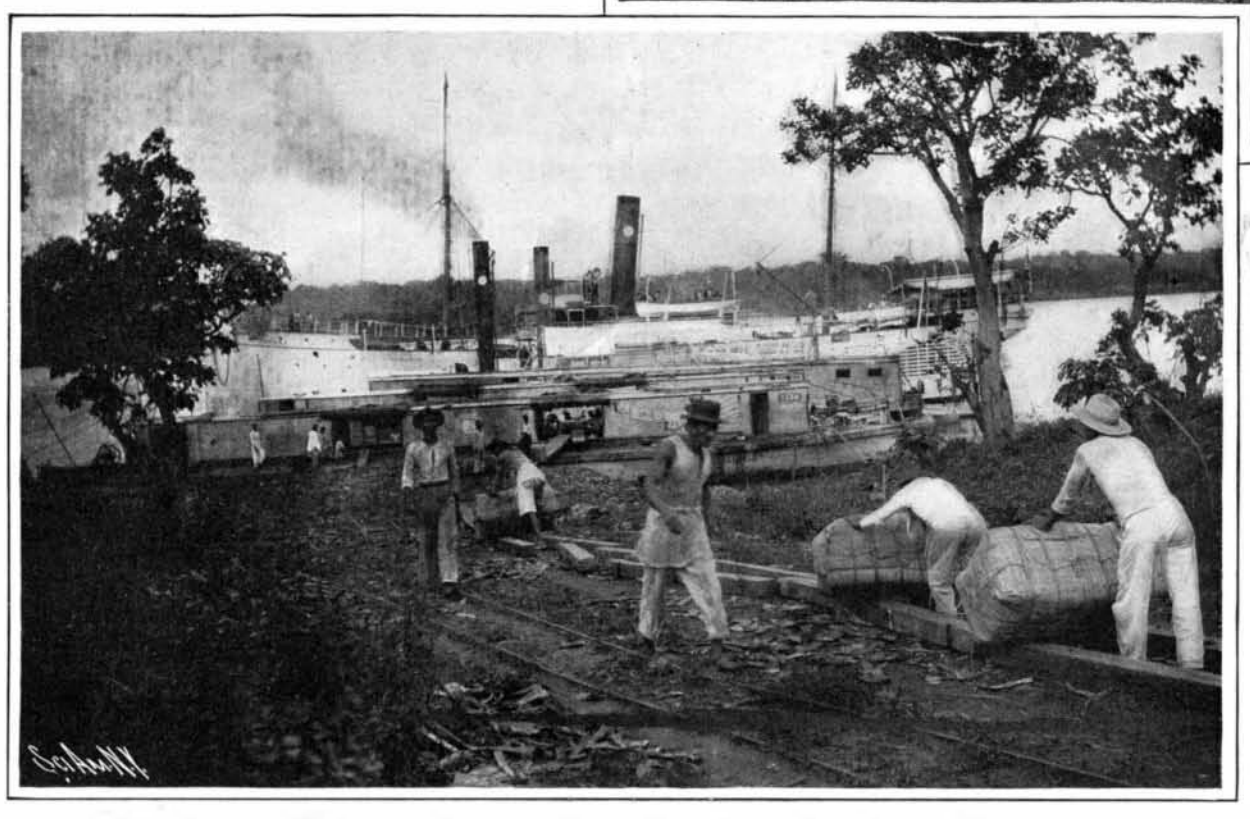
For filling, the inner tube is mounted *in situ* upon an ordinary tire rim with the outer cover in position. The inner tube is provided with two valves—one through which the "elastes" is injected, and the other for the escape of the displaced air. When filled the tire, intact, upon the temporary rim and with the outer cover in position, is set aside for several days to set. It can then be mounted upon the wheel in the usual way. The inner tube is set in position in the rim with a protecting cover of canvas glued on the tread. The outer cover is stretched and secured in the rim as usual. It is claimed that "elastes" will retain its consistency under all variations of load and temperature and is not deteriorated by wear. It has no tendency to harden or disintegrate, and in fact so long as it is not exposed to actual friction can be used over and over again. The one disadvantage that it possesses is that the weight of the car is increased from 20 to 40 pounds per wheel; against this, however, must be set the weight of spare tires which have to be carried under ordinary circumstances. Those who have submitted their cars, with wheels shod in this manner, to practical tests state that the tires thus filled are in every way as comfortable and resilient as the ordinary pneumatic tires.

Prof. A. Agassiz's Scientific Cruise.

The steam yacht "Virginia," chartered by Prof. Agassiz for a scientific cruise to the Windward and Leeward Islands, started on its journey on February 5. To sound and dredge the depths of the sea, to study ocean temperatures, the superficial and submarine currents, are the objects of the voyage. The subject of seismic disturbances, especially in the neighborhood of Jamaica, and of the known seismic area of the recent earthquakes, both on land and seaward, will be carefully investigated. A great change is expected to be found in the soundings about the island of Jamaica. The violent disturbances of the earthquake have caused islands to appear in the Pacific, which later sank thousands of fathoms, with a subsequent settling of the ocean bed. Waterspouts, too, will receive the attention of Prof. Agassiz and his staff. These spouts, Capt. Howland Patterson states, have been known to pursue a straight path for several minutes, then to curve suddenly, and again to rush off at a right angle to their former course. Such waterspouts have foundered good-sized vessels.

Prof. Agassiz commenced scientific investigations in 1859. In that year he went to Acapulco to collect specimens for the Museum of Comparative Zoology at Harvard. He then took up coast survey work in California, where he became a mining expert. He explored the west coast of South America in the early seventies, and sent tons of specimens to the Peabody Museum. He spent five years in deep-sea dredging on board the steamer "Blake," a vessel which the United States Coast and Geodetic Survey placed at his disposal. On his return from his cruise on the "Virginia," Prof. Agassiz expects to be able to add much valuable information to that already possessed by science.





Loading Steamers with Baled Tobacco at Lalloc on the Cagayan River Fifteen Miles from Its Mouth.

Loading Baled Tobacco from the Giant Warehouses at Lalloc in Waiting Steamers on the Cagayan River. Machinery Will be Used Some Day.

TOBACCO RAISING IN THE PHILIPPINES.

Dr. F. V. Darbishire, of Manchester, and Dr. E. J. Russell, of Wye, Kent, dealt with the "Oxidation in Soils in its Relation to Productiveness," before the British Association for the Advancement of Science. All soils, they pointed out, possess the power of absorbing oxygen. They constructed an apparatus to measure the rate of this absorption. The power is mainly due to micro-organisms, but as it continues to about one-fifth of its original intensity in soil sterilized at 120 deg. C. or with mercuric chloride, it cannot be ascribed entirely to micro-organisms. Moisture is essential to oxidation; water-logging stops it; sugar and carbonate of calcium increase the oxidation rate; certain poisons, even mercuric chloride and copper sulphate, increase it likewise, if not present to more than 0.01 per cent. Soils partly sterilized by volatile antiseptics, like chloroform and carbon bisulphide, or by heating up to 95 deg. C., show an improved rate of oxidation, to which greater productiveness corresponds. These results hardly appear consistent, but microbes bear a good deal, and may bear more still when living in the soil.

THE SUBSIDENCE OF A CONCRETE BUILDING.

Since the establishment of the French protectorate over the Beytik of Tunis, its capital, of the same name, has never ceased to grow in extent, population, and wealth. While the Arab city occupied and still occupies the higher and firmer ground, the new French extension spreads from this in the direction of the Bahira or Lake of Tunis to the modern port, which by means of a canal, built at a cost of many millions of French money, traverses the shallow and silting lake, and discharges into the sea at Halg-el-Oued (La Goulette), the former port.

The flat stretch of land, some miles broad, on which the French town is built, is extremely marshy and unstable, a terror to architects and builders. Wonderful are the deviations from the perpendicular and the horizontal which many of the constructions, for the most part temporary, exhibit, collapsing into the shape of the letter X or bulging into O-like forms.

Extreme Displacement from the Vertical.

The Structure After Being Raised to Its Normal Position.

THE SUBSIDENCE OF A CONCRETE BUILDING.

A recent example, however, far exceeding in magnitude and importance any of the numerous previous instances on the above-described marshy ground, and which presented a modern pendant to the well-known leaning tower of Pisa or that of Saragossa, deserves record.

The Société des Minoteries Tunisiennes has had under construction for many months past three large concrete buildings for the storage of wheat and flour, which Tunis now, as did Carthage of old, ships in abundance to Europe. The buildings include a central and two lateral structures which are somewhat separated from the central one. One of the latter was observed to be gradually deviating from the perpendicular, leaning toward the central block, without, however, losing its rigidity, and this movement of the whole structure continued for several hours until an angle of apparently about 25 degrees was attained. The mass gradually displaced itself as a whole, monolithically, as it were, but the collapse of the building was pronounced imminent by all hands. The engineer and contractor, however, took heart, and confident in the cohesion of concrete, set about restoring the immense mass to the vertical.

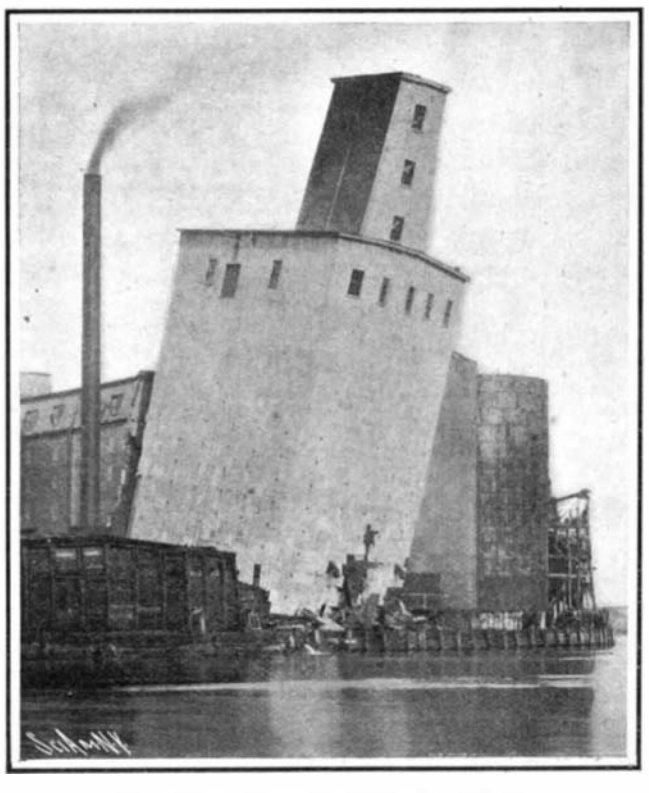
This was duly effected in less than a fortnight. The floors on the elevated side of the building were weighted; this counterpoise consisted of some 4,000 tons of sand in bags on each of the ground or underground floors and 2,000 tons on the upper stories. Excavations were also made alongside the foundations on the same side in order to allow the soil to give way more easily.

The result was all that could be desired under the circumstances. The edifice returned to the vertical in a few days, and was then complete. The construction work proceeded during the summer as if nothing had happened until the 28th of August, which brought another disagreeable surprise to those interested in this important enterprise. The first building had started from the perpendicular in April; the other lateral structure, August 28. The central one remained steady, it may well be, owing to the compression of the ground beneath and around it by the weight of the two side buildings. A few days previous to the latter date, the building had been finished and the engineer decided to load it with 3,000 tons of ballast, for the purpose of testing its stability, and, particularly, of letting it settle definitively. The first and ground floors had been loaded to the extent of about 15,000 tons, and this operation was still going on when the theodolite indicated a slight movement on the side farthest from the central structure. The indicated movements were: 7 A. M., 0.79 inch; 2 P. M., 3 inches; 6 P. M., 9.5 feet; 7 P. M., 11.8 feet; 9 P. M., 13.1 feet; midnight, 16 feet.

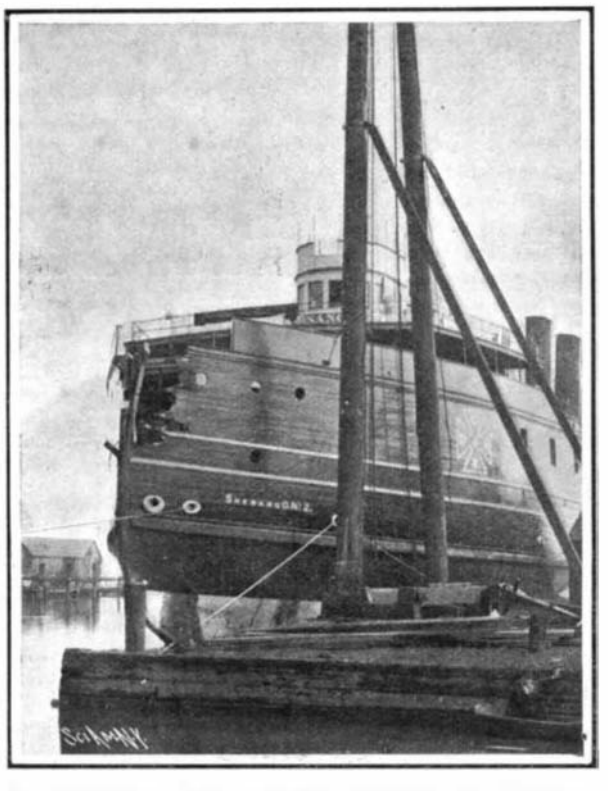
It appears that the center of gravity, around which as a pivot the building turned, was on a line passing through the center of the block. The efforts of the engineer were accordingly directed toward maintaining this center of movement stationary, and the floor of the building on the upheaved side was elevated about three yards above its normal height. The method adopted in April was again employed in August, and with equal success. The material already in the building was transferred to the elevated side. In the case of both buildings the subsidence has been considerable, for both now stand five to six yards below their intended level. The site is responsible for these accidents, which have been a source of no little expense, delay, and vexation. The ground was, however, declared solid enough by an Italian engineer, whose plans were followed. The displaced and replaced buildings remained uninjured and their parts were undisturbed, a wonderful testimony to the cohesion and tenacity of these concrete structures. The armored concrete construction is now, in consequence, lauded to the skies. There are those however who maintain that in such situations, the better course regardless of expense, would be to adopt the Dutch system of building upon a foundation of piles.

A REMARKABLE ACCIDENT.

The accompanying illustrations are from photographs of a strange accident which recently took place at Milwaukee, Wis. One of the elevators of the American Malting Company is located on the bank of the Milwaukee River, upon which considerable heavy traffic is constantly being carried on. A large railroad transfer vessel used for moving loaded railroad cars ran into the bank, owing to a misunderstanding of signals by the engineer. Through this misunderstanding the boat was sent ahead at full speed instead of backing, with the result that it plowed through six or eight feet of piling and concrete and thrust the elevator from its foundations, which extended about four feet above the ground. The force of the impact was such that the elevator was shoved into an adjoining brick malt house, and forced about ten feet into the latter building. The tremendous energy with which the vessel crashed into the elevator is clearly to be seen from the condition of the latter as well as that of the malt house. Incredible as it may seem, the transfer vessel was damaged to a slight extent only, the woodwork of the upper part of the bow being shattered for a few feet, while the lower part of the stem was not even dented. This remarkable fact is surely a strong recommendation for the solid construction of the boat, which was probably intended for heavy work in broken ice.



The Grain Elevator After the Impact.



The Transfer Steamer Which Ran Into the Elevator.

A REMARKABLE ACCIDENT.

New Railway Signal Devices.

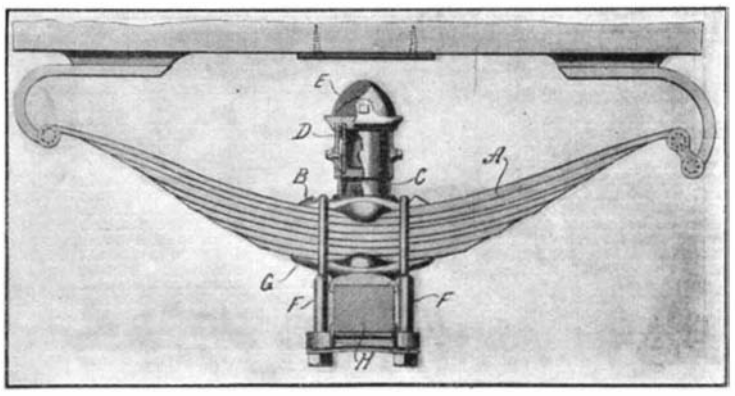
In discussing the recent block signal systems for electric railways, Engineering News states that the North Shore Railway, Sausalito, Cal., is equipped with alternating-current signals. Semaphores are operated by small storage batteries contained in the pedestals. These are charged through high resistances by current from the third rail. Thus power is available when the electric service is shut down for part of the night. Two wires carry alternating current at 2,300 volts for the track circuits and for lighting the signal lamps at night. Upon one of the line-wire poles at the advance end of each block section is a transformer, the primaries of which are connected across the wires above mentioned, while the secondaries are connected with the ends of the track current. Across the rails at the other ends of the track circuit is connected the track relay which operates inductively to close the local circuit controlling the signal. When a car or train enters the block section, this relay is shunted, opening the signal circuit and causing the signal to go to the "stop" position. The Boston and Worcester Railway, operated by trolley, and running through hilly country, has adopted, to avoid rear collisions (the track is double) electrically-worked semaphore arms with illuminated spectacles. The signal works positively at any speed of the cars without throwing the trolley off the wire. The United States Electric Signal Company use lamp signals, in combination with which there may be inclosed disks. Each disk revolves on a horizontal transverse axis passing through its center, for signaling purposes. These, as well as the lamps, are worked by automatic trolley switches and relays. Where cars pass the turnouts at speeds of over 15 m. p. h., a special form of switch, subject to the upward pressure of the wheel, is used, and avoids displacement of the latter. For single tracks this company employs a box at each end of the block section having a large lens with a red disk revolving behind it, the disk having a red bull's eye in the center. In the upper part of the box a green light appears when the "stop" signal is displayed at the opposite end of the block. A car entering a block causes the red target to show at the far end of the section and sets green light at the box just passed. White lights show that the section is clear, and appear automatically when the last car passes out.

The deposits of both lead and zinc ore, whether in association or alone, form most readily in connection with a dolomite or limestone country rock.

Patent Department

VEHICLE SPRING BUFFER.

With a view to relieving the springs of a vehicle from sudden jars under heavy loads, and thus preventing them from breaking, Mr. Peter McKay, of Day Dawn, Murchison, Western Australia, has invented the buffer which we illustrate in the accompanying engraving. The buffer, which is of simple design, may be readily clamped to any vehicle spring. Our engraving

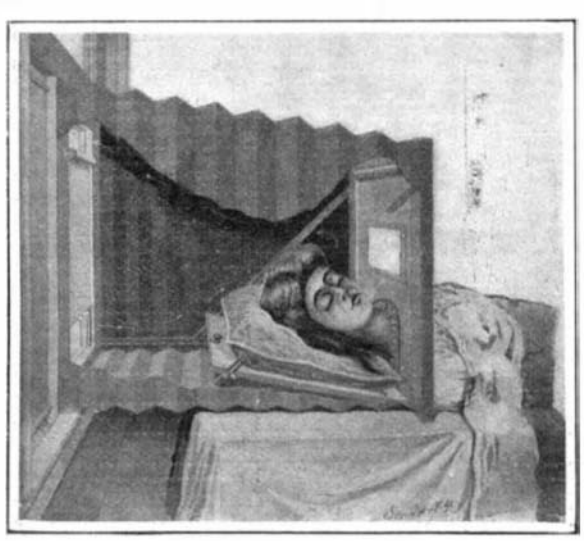


VEHICLE SPRING BUFFER.

shows at *A* a vehicle spring of common type. Mounted on this spring is a plate *B*, which is formed with an annular channel, and in this channel a tubular member *C* is seated and secured. The member *C* telescopes with an upper member *D* formed of two tubes, one within the other, and spaced apart to form an annular recess which the member *C* is adapted to enter. To limit the relative motion of members *C* and *D*, studs are threaded through the outer tube *D*, and project into slots formed in the tube *C*. The inner tube *D* carries a plunger head, which is adapted to engage a block of rubber, secured to the plate *B* within the tube *C*. Mounted on the upper end of tube *D* is a cap plate, which carries a hemispherical block of rubber, over which a cap *E* of softer rubber is secured. The buffer is held in place on the spring *A* by means of yoke pieces *F*, which engage the plate *B* and a plate *G*, fitted against the under side of the spring. These yoke pieces are formed with extensions, which are bolted to a plate that passes under the axle *H*. In operation, when the spring *A* is forced down excessively, a wear plate on the vehicle will engage the cap *E* of the buffer, forcing the plunger head carried by member *D* into engagement with the rubber block on the plate *B*, thus relieving the spring from undue pressure.

FRESH-AIR CABINET.

In the treatment of tuberculosis fresh air is most essential, and in order to obtain plenty of fresh air at night it is customary in many sanatoriums to have the patient sleep with his head within a cabinet which communicates with an open window. A cabinet of this general class, but possessing many valuable improvements, is illustrated in the accompanying engraving. Primarily, the cabinet is collapsible and when not in use may be folded into a small compass. In addition to this the invention provides a curtain at the outer or window end of the cabinet which may be raised or lowered to regulate the amount of air admitted, while the opposite end of the cabinet is equipped with a curtain arranged to fit snugly around the throat of the patient so as to protect the body from drafts and exposure. Our engraving shows the cabinet with one side removed so as to reveal the interior details. The main frame of the cabinet is extensible laterally, so as to closely fit any size of window frame. In its extended position it is secured by means of thumb screws. The bottom of the frame which rests on the window ledge, and the top of the frame on to which the window sash is lowered, are provided with weather strips of flexible material. The frame at the opposite end of the cabinet is adapted to rest on the couch or bed, and is connected with the main frame by means of brace rods which are slidable upon each other and adapted to be held in extended position by means of thumb nuts. The front and rear frames are also connected by means of a hood in the shape of a camera bellows. The curtain at the front end of the cabinet is mounted on a spring roller which is spaced a short distance from the upper end of the frame to provide an air passage. The curtain may be lowered to any degree desired and is held in place by means of spring-pressed rods bearing against the side of the frame. A similar curtain is mounted at the inner end of the cabinet on a roller which is placed at the top of the frame. The lower portion of this curtain is provided with an arched opening braced by a wire rod and provided with a flexible flap which rests against the throat of the patient. In this curtain there is a small window covered with transparent celluloid. Within the cabinet is a pillow rest which consists of a board hinged at one end to the rear frame, and suspended at its outer end by means of hangers from the upper end of this frame. The hangers are slotted to receive threaded studs projecting from the pillow rests and, by means of thumb nuts on these studs, the rest may be secured at any desired position. Our engraving shows the cabinet in use and the course of the air through it is indicated by means of arrows. The inventor of this improved cabinet is Mr. J. H. Williams, of Columbia, S. C.



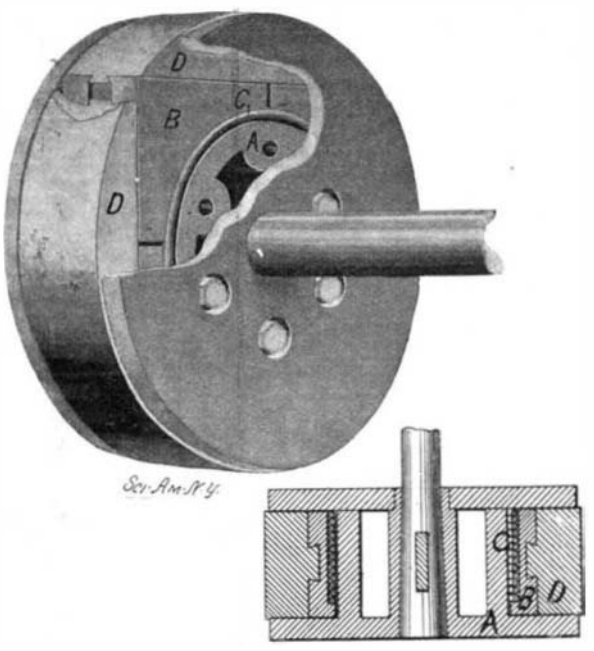
A FRESH-AIR CABINET.

The Current Supplement.

The current SUPPLEMENT, No. 1624, opens with an article on "The Passing of American Square-Rigged Vessels," by James G. McCurdy. Mr. F. C. Fish thoroughly discusses the ethics of trade secrets, and likewise presents much legal information that must be of interest to inventors. Mr. A. Frederick Collins writes on the making and use of a wireless telegraph tuning device. This article is naturally to be read in connection with the previous articles by Mr. Collins on "The Design and Construction of a 100-Mile Wireless Telegraph Set" (published in SCIENTIFIC AMERICAN SUPPLEMENT 1605); "The Location and Erection of a 100-Mile Wireless Telegraph Set" (published in SCIENTIFIC AMERICAN SUPPLEMENT 1622); and "The Installation and Adjustment of a 100-Mile Wireless Telegraph Set" (published in SCIENTIFIC AMERICAN SUPPLEMENT 1623). One of the difficulties which every wireless telegrapher experiences is that of bringing the receiving circuits of the receptor into sharp resonance with the oscillation circuits of the transmitter. How this is accomplished Mr. Collins explains by the help of diagrams in the present article. Mr. Elihu Thomson writes authoritatively on alcohol engines as a future power. The Hon. Sir Lewis Michel, well known as one of the late Cecil Rhodes's associates in South Africa, contributes an excellent article on the Cape to Cairo Railway. Dr. H. W. Wiley, who is responsible for the pure food law, states how the whiskies of Great Britain and Ireland are made. Among the minor articles of interest may be mentioned those on "Varnish," "The Valuation of Bread," "Treatment of Concrete Surfaces," "Selecting the Proportions for Concrete," "Vibrations of Passenger Cars," "Development of the Frame of Freight Locomotives," "Some Requirements of Carbureter Design."

METALLIC PISTON PACKING.

The accompanying engraving illustrates an improved metallic piston packing composed of comparatively few parts, and arranged to prevent leakage of steam in the cylinder from one side of the piston to the other. In addition to this, the device is so designed as to compensate for all wear of the interior contacting surfaces of the engine cylinder and the packing, thus requiring no reboring of the cylinder. As pictured in the engraving, the improved packing is arranged between two heads keyed to the piston rod. The head *A* is formed with a spider, which serves to space the heads apart and provide an outer annular recess between them. In this recess the blocks *B* are fitted, and between them and the spider are a series of springs *C*. There are four of these blocks *B*, and their inner edges are curved to fit against the springs. The outer edges of the blocks are angular, and are formed with dovetailed grooves adapted to receive dovetailed tongues on the segments *D*. It will be observed that the aligned edges of two adjacent angular blocks are engaged by one segment *D*, and in order to insure a complete fitting of the segments on the blocks, two opposite segments are formed, with longer dovetailed tongues than the intermediate segments. The segments *D*, it may be observed, are formed with curved outer faces adapted to engage the inner surface of the cylinder. In practice the springs *C*, pressing against the blocks *B*, hold the segments *D* in firm contact with the cylinder, and consequently all wear between the contacting surfaces

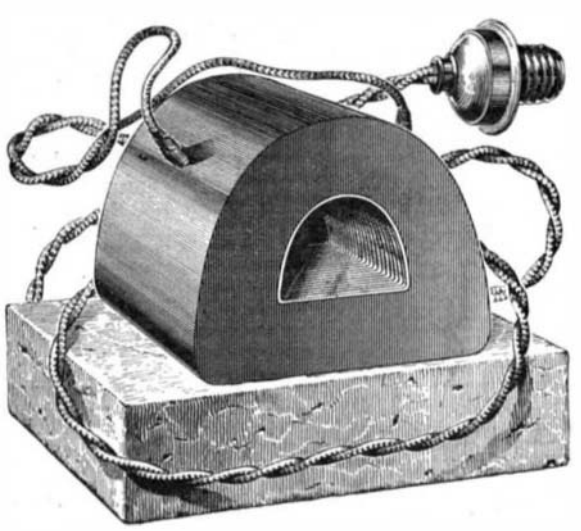


METALLIC PISTON PACKING.

is compensated for, and leakage of steam from one side of the piston to the other is completely prevented. It will be seen that by providing dovetailed connection between the blocks and the segments, they are held together, but allow sliding movement of the segments on the blocks without danger of their becoming disconnected. While this packing is applicable on any engine it has been designed particularly for use on locomotives. The inventor of this improved piston packing is Mr. N. Pflaum, 77 Schmidt Building, Pittsburg, Pa.

A NEW ELECTRIC FURNACE.

At the recent meeting of the American Association for the Advancement of Science, an electric furnace of novel type was exhibited by Prof. William H. Bristol, of Stevens Institute of Technology. This furnace is of the form used by dentists and in laboratories to heat small articles, pieces of metal and the like, to a high degree of temperature. As ordinarily constructed, furnaces of this character consist of a receptacle formed of clay in which a coil of fine wire is embedded. As this wire is heated it expands more rapidly than the clay, and tends to crack the receptacle, unless the heat is applied very slowly. Ordinarily, it requires from ten to fifteen minutes to bring the furnace safely to maximum heat. Prof. Bristol's furnace consists of a receptacle of fused quartz wound with the wire of the heating coil, each turn being insulated from the adjacent one by a cord or thread of asbestos. The heating chamber thus formed is then incased in a refractory non-conducting material, such as asbestos. The coefficient of expansion of quartz is extremely low, and as a consequence, it may be suddenly heated or cooled over extreme ranges without cracking. Hence, the full current may be applied at once to the quartz-lined furnace, and the maximum heat will be attained within less than a minute. The heating coil is made of platinum or platinum alloy wire when temperatures as high as 2,300 deg. F. are desired for hardening high-speed steel. For the treatment of carbon steel, at temperatures up to 1,600 deg. F. it is expected that nickel wire may be used for the heating coil. A number of these furnaces are now being employed in a manufacturing plant for hardening small, round pieces of carbon steel.



A NEW ELECTRIC FURNACE.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ARM-SCYE BUST-FORM.—C. H. SCOTT, New York, N. Y. The principal objects of the invention are to overcome various objections by providing a form light and comfortable and produce an attractive and symmetrical figure besides providing for the better fitting of outer garments; also, to provide for the escape of heat or air confined between the pad and the body. The scye is so constructed as to full in the deficiency of an undeveloped bust from the shoulder downward in front to the part of the scye underneath the arm.

LADY'S COMB.—W. J. WATSON, Shawnee, Oklahoma Ter. The invention refers to ladies' combs, and particularly to the side combs and back combs which are worn in the hair. It is also applicable to hair-pins. The object of the invention is to produce a comb of this class which is simple in construction and provided with means for preventing its becoming accidentally displaced.

Electrical Devices.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.—L. KOTTMAIR and R. ZWACK, 86 Lilienstrasse, Munich, Germany. This improvement relates to an apparatus for setting the points and signals on railways by means of electric actuating devices in such a manner that these actuating devices act upon the separate points and signals in succession, so that when an electric switch belonging to a line is closed each actuating device after being properly set closes the circuit of the next. The whole or a portion of the actuating devices belonging to the track are thus automatically set.

Of Interest to Farmers.

PLATFORM LEVELING DEVICE FOR HARVESTERS.—E. R. GORDON and D. R. THROOP, Harrington, Wash. In this instance the invention pertains to a new means for simultaneously raising and lowering the main wheels on the opposite side of a harvester, reaper, or other similar vehicle in order that the body of the vehicle may be maintained in a level position, irrespective of the inclination on a hill upon which the harvester may be used.

Of General Interest.

FILTER.—E. BURT, El Oro, Estado de Mexico, Mexico. In this patent the invention relates to high-pressure filters for precious-metal-ore slimes, as gold, silver, etc., having among other objects the production of an apparatus of this character of large capacity capable of filtering the slimes expeditiously and at a comparatively low cost.

GUN CLEANER.—C. T. FORBES, Fresno, Cal. The invention has to do more particularly with a form of handle for attachment to the outer or rear end of the cleaner-rod; and the object is to provide a handle adapted to permit free turning or rotation of the rod and the fixedly-attached swab at its inner end with the handle held against turning action.

SCRAPER AND REGULATOR.—J. H. YOUNG and G. B. YOUNG, El Paso, Texas. The invention is an improvement for use in making bricks of ice-cream of different kinds of layers of cream in a suitable mold. The ice-cream scraper and regulator comprises a plate having at its edges a projecting rectangular tongue or tongues and a triangular tongue.

Household Utilities.

COMBINED LOUNGE AND FOLDING BED WITH A CANOPY.—P. P. LAGRANGE, New Orleans, La. The object in this case is to provide a device which will comprise the necessary mechanism to adapt it to be used as a lounge when folded, and also to be easily opened into a complete bed with a canopy, which will be as complete, attractive, and comfortable as the common form of bed which is not constructed to perform any other function.

COMBINED SHAVING MUG AND BRUSH.—G. A. RONEY, Grand Forks, N. D. The invention consists of a cup or mug having a displaceable handle adapting it to normally lie in the mug when not in use and a cap or top to close the mug to keep it free of dust, dirt, or other foreign material. The top carries a brush having an extensible handle, which is also inclosed when the mug and top are in assembled relation.

WATER-STILL.—O. A. NENNINGER, El Paso, Texas. Steam passes into a boiler-pan, thence upwardly into a condensing-chamber, said steam being condensed flows back into the distilled-water pan. Circulation of water in the boiler-pan is maintained, and air to aerate distilled water is admitted, the steam drawing the air into the chamber. Water in the cylinder when heated may be drawn for house uses. Warm water is supplied the boiler-pan from the cylinder. When hot water is drawn from the cylinder a valve opens and cold water from the main forces out the hot. The valve opens likewise when warm water passes from cylinder to boiler-pan. Means provide against entrance of foul air in the chamber and against escape of steam.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10380) P. M. C. says: We desire some cheap adhesive substance that can be used in manufacture of briquettes to contain charcoal and sawdust. A. Coal tar and molasses are the substances used for briquetting, and are both quite cheap.

(10381) B. D. wishes a receipt for a glue that will satisfactorily glue celluloid to wood, such as is used in making draughtsman's tie squares of celluloid and wood. A. A very simple formula recommended for this purpose is to heat glue to boiling, and stir in gradually wood ashes until the consistency is similar to a thick varnish. Use hot.

(10382) C. C. A. says: I have a gas engine cylinder that leaks water through fine holes in the cylinder wall near a boss, the holes evidently being caused by the "draw" of the iron in cooling. Can you suggest any method of dosing these pores solidly enough to stand the heat and pressure of explosion? A. The application of a saturated solution of sal ammoniac in water to the spongy surface will soon rust up the leaky places.

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AND EACH BEARING THAT DATE

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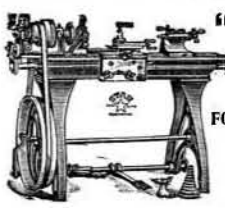

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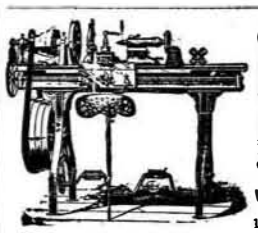

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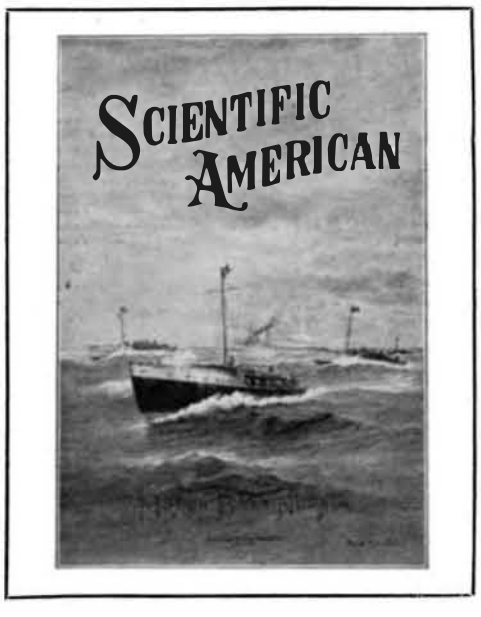
OUR Motor Boat Special, which will issue February 23, during the Motor Boat Show, will contain all that is new in this growing industry and sport. Some of the fastest of the American and Foreign motor boats and their engines will be illustrated and described. Plans and descriptions of comfortable cruisers and pleasure boats for the ordinary user will also be published. A prominent feature will be an article telling what has been accomplished the past year with the new type of gliding boat for which much was prophesied in our last motor boat number. There will be many novelties which will appeal to the motor boat user, and the issue will undoubtedly reach a large number of people interested in launches, yachts and racing motor boats.



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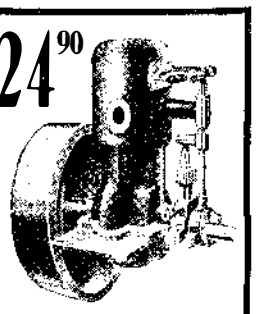

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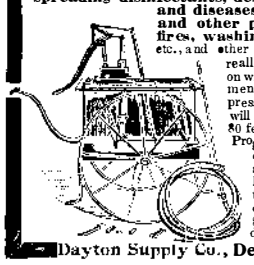

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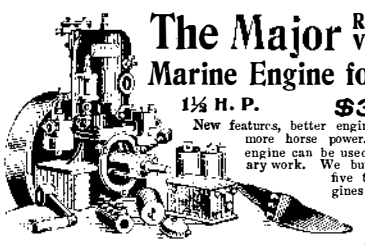

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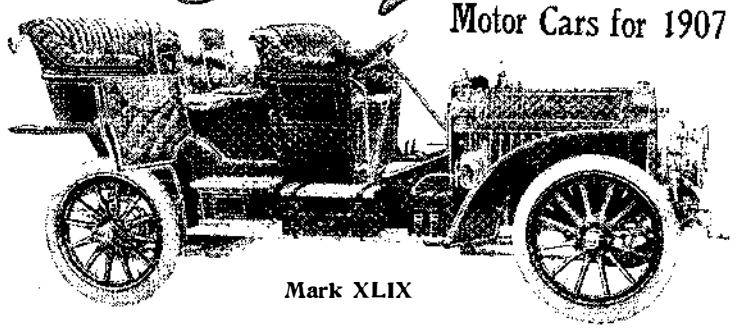

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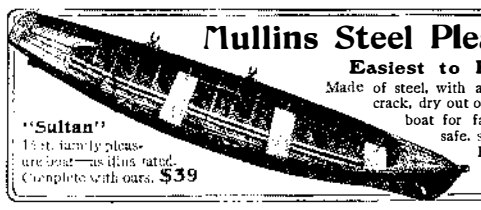

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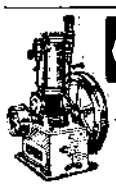

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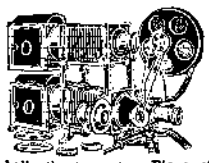

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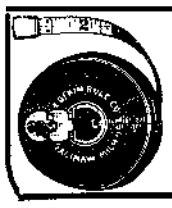

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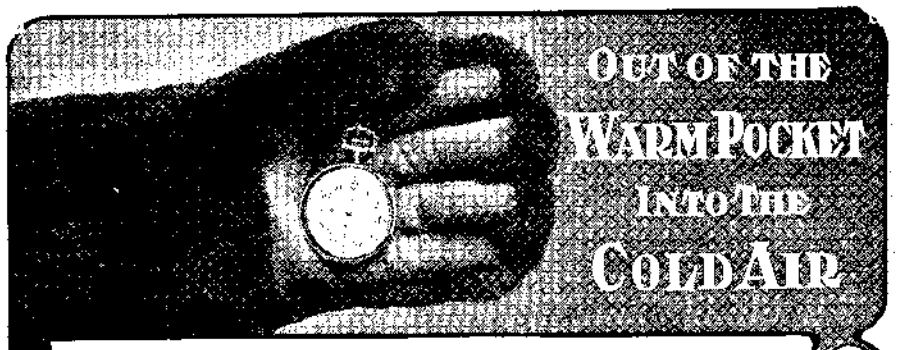

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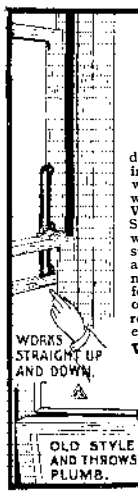

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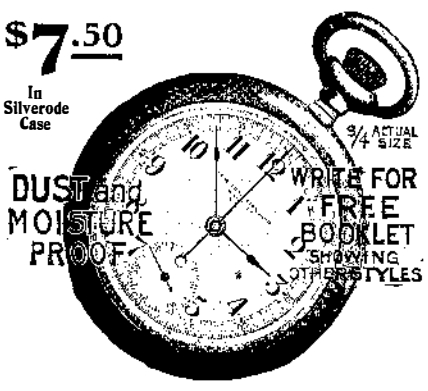

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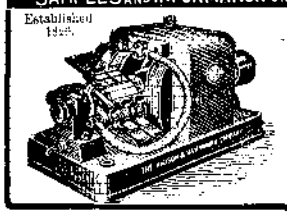

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